ABOUT OURSELVES

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MAN'S DEVELOPMENT AND BEHAVIOUR FROM THE ZOOLOGICAL VIEWPOINT

by

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To the Memory of My Wife
ANNA TAYLOR NEEDHAM

PREFACE

This is a book about ourselves, individually and collectively. We are something more ethereal than "featherless bipeds" and something more substantial than "such stuff as dreams are made on." Substance and action at least are observable and a vast deal of knowledge has become available in recent years to those who seek it. I have endeavored to assemble and to present in simple untechnical form some of the basic zoological facts that must be taken into account in any penetrating study into the nature of human kind.

Bound as we are to all animal life by ties of tissue and cell and organ, by bonds of breathing and of feeling; bound to the higher ranges of that life by blood and bone and brain, by nurture, first in a mother's womb and then in a mother's arms, it would be very stupid of us to ignore the meaning of our zoological heritage, and so miss the beginnings of the story that it tells of the coming into dominance of mind and the gathering together of the first materials for a social order.

The ultimate concern of biology is with that part of human life wherein emotions mix with rationality, contributing when the mixture is good to our welfare and happiness; when bad, to our confusion and disillusionment.

This book is an exposition of human nature, without any plans for its improvement. The lack of such plans is due to my fear that Mother Nature would not be very regardful of them; that she will go right along making

our successors after her regular patterns, and that they will continue to behave very much as we have done.

I present herewith a very condensed statement of some of the contributions of zoology to the knowledge of the nature of our species, together with some suggestions as to the relation of these matters to the organization and operations of society. The limitations of space have demanded that the facts be stated broadly, and without much heed to exceptions.

In the following pages there is little that is new, but the classification of the components of social behavior and of the instincts that serve the needs of our mind is my own.

I am greatly indebted to Dr. William D. Sargent for his interpretative illustrations; to Mr. A. R. Hilliard for improvements in the form of the text; and to four of my scientific colleagues, Doctors Cornelius Betten and Benjamin Freeman Kingsbury of Cornell University, Doctor E. G. Conklin of Princeton University, and Doctor Alexander Wetmore of the United States National Museum, for careful reading and helpful criticism of the manuscript.

Ithaca, New York.

JAMES G. NEEDHAM

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INTRODUCTORY

Our chief joys in life are the free gifts of Mother Nature. Our worst troubles are ills of our own creation. Surveying present world conditions, we are shocked to see our most potent knowledge turned to destructive ends. Perhaps it is dangerous for us to know so much about control of the external world forces without knowing more about the impulses that control our own lives: about our own nature and its limitations.

If we would know ourselves, the living world demands our thought; for of it we are a part. We and the animals are the sentient part of it; the part that feels and breathes and acts. We and they alone are gifted with powers of will. Like them we are born and grow old and die. Like them we struggle to get a livelihood, and to provide for our precious offspring. We are partakers with them in life's serene moments, and also in its vicissitudes. In all things fundamental to the welfare of living beings their ways are our ways.

It is because of this likeness that we are so interested in the doings of animals, and find so much pleasure in

seeing how they live and how they behave; how they forage and frolic and fight; how they get themselves homes in nest or burrow; and by what cunning devices they capture their prey and elude their enemies. We take delight in their joyous antics, and in their overflowing zest for living. We are often stirred to emotion when we see with what tender solicitude a mother animal guards her brood; for animals are moved by the same instincts that are the springs of our own human conduct.

We are distinguished from animals chiefly by the cravings of our minds. We seek to know. Of all creatures on this earth, we of the human species are the most inquisitive. We share with animals certain states of mind—joy, fear, anger, curiosity, etc.—and manifest them by like behavior. We probably do not get more frightened or more angry than some other creatures, but we are far more curious to know about things. Therein lies a difference that in its cumulative results sets us so far apart from other living things as to make us seem like another order of beings.

We and the animals have been a very long time on this earth together. We have developed together; and in the beginning of our individual lives we still travel for a time the same old embryonic highway; it is the main-travelled road of physical development, our branch of which leads up to the heights where a higher mental life begins. We travel a little farther at the end, and reach then a field of greater freedom of action that is all our own.

It was a great day in the history of human origins when some of our gifted remote ancestors, seeing the gains

that could be made by exceptional individuals, set about to preserve these gains by the simple method of taking thought and keeping records. When men began to alter and improve their natural environment by combined observation and experiment, then humanity set out on a new road of its own—a rough road, a steep road, but a road of glorious prospects and of future promise.

As I take up my pen to undertake this story, I wonder whether I shall be able to tell it briefly and in simple language. I'll try.

This is the plan to be followed here. We may learn something about ourselves individually by tracing our structure, our development and our first steps in learning back to their sources in the animal world (this, in Part I, which now follows); and then we may learn something about our collective behavior by comparing it with the doings of the more social animals (this, in Part II).

So in the following chapters we will consider first likenesses and differences in bodily organization; then behavior in the making; then social behavior in its zoological aspects. In this we will be following the counsel of the wise as embodied in the ancient maxim:

"Look well to beginnings."

THE UNITY OF THE LIVING WORLD

If there be one fact of more profound significance than any other, more basic to an understanding of our place in the living world, it is the fact that we share life's most fundamental characteristics with all living things,

both plants and animals. These biological fundamentals are four, and may be briefly stated as follows:

1. In all living creatures there is one common substance, *protoplasm*, the physical basis of life, the only known living substance. It is a semifluid substance, transparent, well nigh structureless, and apparently inert, yet possessing the unique powers that distinguish living from non-living things, the powers of *growth and reproduction.*

Protoplasm is capable of taking up in solution the stuffs of the non-living world and building them into its own substance; not only ingesting them, but also digesting and assimilating them, and making of them new substance in its own likeness. It is capable also of getting rid of waste materials and of building hard parts both for external defense and for internal support.

Protoplasm is a soft watery substance to which evaporation is a great peril; so it hides itself behind protective coverings of its own making, and we do not see it except as it is prepared for the microscope; yet it is the living part of every living thing. It is this amazing substance that has clothed the earth with verdure and peopled it.

2. In common with other living things, man has one unit of structure and of function, the *cell.* This is a microscopic bit of protoplasm organized for business. It consists of a sort of control center, the cell nucleus, surrounded by a more fluid portion called the cytoplasm. It may build about itself a cell wall, and it may retain within that wall certain non-living substances, such as food products stored as a reserve supply, or waste products resulting

from its own activities. It may build its wastes into the solid elements of a supporting skeleton.

The cells of the body vary greatly in size. None of them is large enough to be visible to the unaided eye. In form the cells are remarkably diversified according to the work they have to do.

There is nothing composing the human body but cells and cell products. All life is at bottom cell life. The work of any organ, be it stomach, lung, or brain, is the result of the activity of the cells composing it.

3. In common with all other living things man's body has one mode of increase, *cell division.* This process follows upon growth. Cells have a normal stature, and when this is attained they divide. Each cell cleaves itself into two daughter cells. Division prepares the way for further growth. Division begins in the nucleus, where a segregation process of marvelous intricacy (known as *mitosis*) insures an equitable allotment of the essential cell materials. Thus ordinary cell division tends to direct further growth along lines of uniformity.

4. In common with all other living things man has one mode of mixing strains, *cross-fertilization.* This involves sex cells of two complemental sorts, developed for the purpose of reproduction, and differentiated as follows:

The egg: very large, containing yolk for an initial food supply.

The sperm: excessively small, long-tailed, and active, capable of swimming to meet the egg.

These sex cells are alike, however, in their nuclear equipment, which appears to be the chief mechanism of heredity.

Sexual reproduction involves two parents each of which contributes one cell from its own body toward the formation of an offspring. One egg combines with one sperm to form the fertilized egg from which a new individual may develop.

The sex cells, coming from two sources, are of different lineage, and they bear diverse characters that are separately heritable. They thus provide for change, for new combinations of characters in the offspring.

These four basic facts lie at the foundation of biological science. Before the invention of the microscope they could not be known. Plants and animals seemed vastly different until this precious instrument revealed the fundamental unity of the living world. Where else in nature can we find such unity as that which the microscope has revealed?

ANIMAL CHARACTER OF THE HUMAN SPECIES

Now we will take leave of plants and consider only animals, and these only in so far as in structure and behavior they show resemblances to our own kind. Our bodies are much like those of animals; like all animals, as we have just seen, in their more fundamental biological characters, but in minor characters like fewer and fewer of them as we proceed up the grade of animal organization. Let us briefly note and ponder these likenesses.

A. In common with *all* other animals we have:

A special development of *sensory and motor appa-*

ratus, that confers powers of quick and definite response to stimulation. Nerve and muscle belong to animals and not to plants.

Also we have a *food receptacle* for taking in more or less solid or concentrated foods preparatory to their digestion. Plants gather their foods slowly, and from dilute solutions. They extend their rootlets widely through the soil, reaching for dissolved mineral salts; they spread their leaves broadly to the sun, gathering their carbon from the air. Plants are the world's first food producers; animals are the great consumers, requiring for their sustenance the organic stores that plants have accumulated. Man's stomach is his most ancient animal organ.

B. In common with *coelomate animals* (animals other than the most primitive, such as protozoans, hydras and sponges) we have, among other things:

A *food tube* extending through the body from end to end. Thus the body plan is that of a tube within a tube: the inner tube is the alimentary canal; the outer one is the body wall. Between the two tubes is the space known as the body cavity (or coelom, whence the group name), in which lie the interior organs: liver, lungs, pancreas, etc. This plan is clearly seen in a worm in which the food tube is straight and simple. It is less obvious when that tube is lengthened and convoluted, as in man.

The lowly hydra has merely a food sac. (See figure on p. 52.) Through its single opening food is taken in for digestion, and through the same mouth opening the indigestible residue is later thrown out. The transformation of a food sac into a food tube was one of the great

evolutionary advances in animal organization. In mechanical terms we may say that it substituted continuous processing for batch treatment of the food, with accompanying mechanical and physiological advantages.

We have also complicated *systems of organs*, digestive, circulatory, respiratory, etc., and a correspondingly high degree of division of labor between the parts of the body.

C. In common with other *vertebrate* (back-boned) *animals* we have among other things:

An *internal bony skeleton*. True bones are peculiar to vertebrate animals. Most other animals wear their skeletons on the outside (crabs and oysters, for example), where they serve as defensive armor.

Two pairs of appendages, arms and legs (which may elsewhere be wings and legs, as in birds, or paired fins as in fishes, or all legs as in most vertebrates, but which are always two pairs). There are three pairs of legs in insects, four pairs in spiders, five pairs in crabs, and many pairs in centipedes and millipedes.

Red corpuscles in the blood. The blood of invertebrate animals is generally colorless, and always lacks red corpuscles.

D. In common with other *mammals* (animals that suckle their young) we have among other things:

Nurture before birth by means of embryonic membranes. Something more will be said about these in Chapter X.

Nurture after birth by the milk of the mother (as the name *Mammalia* indicates).

A body covering of hair; rather scanty, to be sure, but strictly mammalian.

A skull that rocks backward and forward upon two bony condyles at its base: two knobs of bone that rest in a pair of hollows in the sides of the topmost (Atlas) vertebra.[1]

E. In common with other animals of the *Primate* group (apes, monkeys, lemurs, etc.) we have among other things:

Hands that are fitted for grasping.

Binocular vision: both eyes fixable on an object at the same time.

Mammary glands on the breast.

F. In common with the large *anthropoid apes,* the animals most like himself, man has among other things:

A large forebrain, our chief physical endowment.

A more or less erect stature.

A lack of tail.

Thus as we ascend the scale of animal organization the differences become less and less; the likeness becomes unmistakable, and the apes just mentioned are fittingly called anthropoids.[2]

[1] We mammals, with only seven vertebrae in our necks, have a curious mechanism in the two uppermost of them. The topmost one, the Atlas vertebra, is so named because it holds up our head even as the fabled Atlas held up the earth on his shoulders. It makes with the condyles of the skull a pair of hinge-like joints. It articulates with the second vertebra (the Axis vertebra) by means of a sort of wheel-and-axle joint for swinging in a horizontal plane. The Atlas vertebra is perforated by a vertical hole somewhat like that in the hub of a wheel, while the Axis vertebra rears a slender axle-like process that fits into the hole and around which the Atlas turns. So, the pair of hinge joints at the base of the skull enables us to nod our heads in assent; the wheel-and-axle joint below it allows us to shake our heads in disagreement.

[2] Greek: *anthropos,* man and *oid,* like.

As in structures, so also in functions, the likenesses between us and animals are much greater than the differences. Digestion, respiration, secretion, excretion, reproduction and all other bodily functions are performed in the same way. So true is this (and so important for our welfare) that human physiology is studied in the main by experimentation on animals. The first test of a new remedy for a human ailment often consists in "trying it out on the dog" or, better still because of the greater likeness, on a monkey.

The blood of the anthropoids is the only kind of animal blood that may be transfused into the veins of man without producing fatal results.

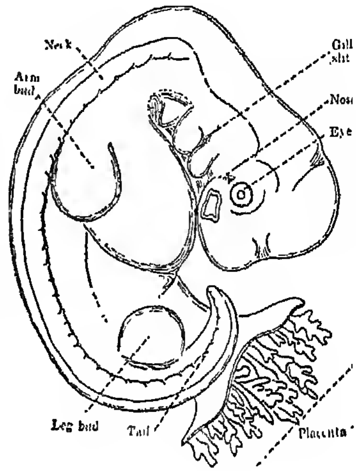
We and the terrestrial vertebrates have similar reactions to physical environment. In the heat we and they sweat; in the cold we chill; in the sun we tan; and in the shade we bleach.

We have similar reactions to medicines; cathartics, soporifics, narcotics, stimulants and sedatives have similar effects when taken into the body.

There is but one good explanation of such extraordinary likeness in structure and function, and that is common descent: blood relationship.

Further evidence of kinship is found in the manner of development of the human body. It starts at the common level, a single cell, the fertilized egg cell. Its earliest development is like that of the lower invertebrate animals. The egg divides repeatedly, forming tissues and organs. At one month's development the human embryo looks more like a primitive salamander than like a man, for there

are gill slits on the sides of the throat, the arms and the legs are similar little rounded buds, and there is a tail a fifth as long as the body. It is by this time obviously a vertebrate animal; but if seen apart from its environment by anyone who knew nothing of embryology it would not be taken for a human being.



A human embryo after four weeks development, when about a fifth of an inch long.

There is no way by which animals come into being other than the old way by which their ancestors came. The logic in the process is that of necessity: each step in development determines, limits, and conditions the steps that must follow it. The Patriarch, Job, truly said "A man is born like a wild ass's colt."

Clearly the human body is an animal body like that of other animals in its parts and in their functions, in its origin from a fertilized egg, in the derivation and order of appearance of its parts in development, and in its phases of youth, maturity and age. The human mind also is like the animal mind in so far as it is ruled by appetites and instincts; and that is very far.

DISTINCTIVE PECULIARITIES OF THE HUMAN SPECIES

Compared with our nearest zoological relatives, the anthropoid apes, our bodies show great likeness in every

part, with only minor structural differences. Yet these little differences are important, for collectively they in part explain the vast difference in activities between our species and all others. They are all correlated characters having to do with a more erect attitude of body, and better brain development. We may briefly list the more important of them as follows:

A double curvature of the spine enables us to stand erect, and not in the slouching attitude of the ape.

Our skull is better balanced on the top of the spinal column, and not slung forward from its summit as is the ape's.

Our arms are relatively shorter and our legs longer and stronger than are the ape's.

Our arms are capable of more complete rotation at the wrist.

Our hands are better developed, with more complete mobility of the fingers.

Our thumbs are stronger and more readily opposable to the fingers for grasping.[3]

Our chest is broader and flatter, and our shoulder blades lie more nearly flat upon the back.

The soles of our feet are turned downward and much more broadly applied to the ground.[4]

Our hip bones are stronger, and better consolidated with the lower end of the spinal column. They have to bear the entire weight of the body.

[3] The three last named characters clearly have much to do with manual dexterity. Thus human handicraft is implemented.

[4] Apes walk on the outer edge of the foot with the sole turned inward. v see to what extent we do the same by noticing the prints of eet on the bathroom floor.

Our cranium is larger, giving more room for brain, especially for the forebrain. Alterations in the form of the skull appear in a greater prominence of the forehead, in recession of the jaws, in lowering of the bony ridges above the eyes, and in other correlated characters.

Our chin is more prominent, and the lower jaw more widely arched in front. Greater breadth at the chin may have favored the development of speech by allowing more room for the tongue to wag in.

In the brain itself, the parts are all similar or identical in man and ape. The differences are only in degree of development. The parts concerned with the higher functions of the mind are better developed in man.

MAJOR AND MINOR DIFFERENCES

It is of course well known that no two individuals of any species are exactly alike. They differ in many minor particulars. Think of hands, for example: always of one general pattern, with four fingers and a thumb on each and all armed with nails, yet never alike in two persons. Hands have their features, as well as the face.

There are well known superficial differences in the hands of people that are due to environment. Some hands are soft and white with scented and tinted nails, and others are rough and worn with calloused palms: differences due to the unlike tasks that have fallen from life's lottery. There are other differences that lie deeper, hereditary differences, that run in families. Our own hands show some characters that are like those of our immediate ancestors, such characters as appear in breadth and thickness of nails and in length and taper of fingers.

When we look at our palms we see that they are crossed by interlacing lines of wrinkles the details of which are not quite alike in our two hands, and are never the same in two persons. *Palmistry, the pretended art of reading character or fate in these lines, is* based on these "portentous" differences.

When we look more closely at the pads of our finger-tips we see that the skin is traversed by fine raised concentric lines that are not exactly alike on any two of our fingers. They are never alike on two persons. They differ so much that we may be more certainly identified by finger-prints of these lines than by our own written signatures.

So much for the individuality with which Mother Nature has endowed us out of her infinite resources; but, as is her wont, she has held us strictly to her general hand-pattern. There are other hands than those of people, as we have just seen. Our nearest animal allies, the Primate animals, apes and monkeys have them. Four fingers and a thumb is their pattern as well as ours. When we trace this pattern to its source among more primitive animals we find the nails fading into claws.[5]

Before there were hands there were only front feet. Our animal antecedents travelled on all fours and used their hands for locomotion (as we still do in infancy). Haltingly our progenitors stood up, releasing the hands from bearing the weight of the body and freeing them for other uses. One of the five digits became a thumb,

[5] In another line of animal evolution (that of the ungulates: cattle, horses and hogs) fingers were reduced in number and claws blossomed into hoofs.

greatly improving the forelimbs for grasping. Then hand and brain developed together.

That is one little item in the long story of human evolution.

A BIRD'S-EYE VIEW OF THE ANIMAL KINGDOM

There are two ways of expressing relationship, both long familiar in zoological text books. One is by means of a systematic table; the other, more graphic, is by means of a genealogic tree. We will now indicate our own position in the animal world by each of these methods. In both we follow through but a single line of development, the one that leads to our own place, omitting all others from further consideration.

First, *Systematic Classification* is shown in the accompanying table. The column headings are the names of the groups into which all animals have been arranged since the days of Linnaeus:[6] Phyla or branches (primary divisions), classes, orders, families, genera and species. They are arranged in the order of their inclusiveness, the smallest group being the species. A species contains only animals that are essentially alike. The scientific name of an animal, as every one knows, consists of generic and specific names, set down in the order in which men's names are written in a directory, the more inclusive one first: *Homo sapiens,* man; *Felis domestica,* cat, etc.

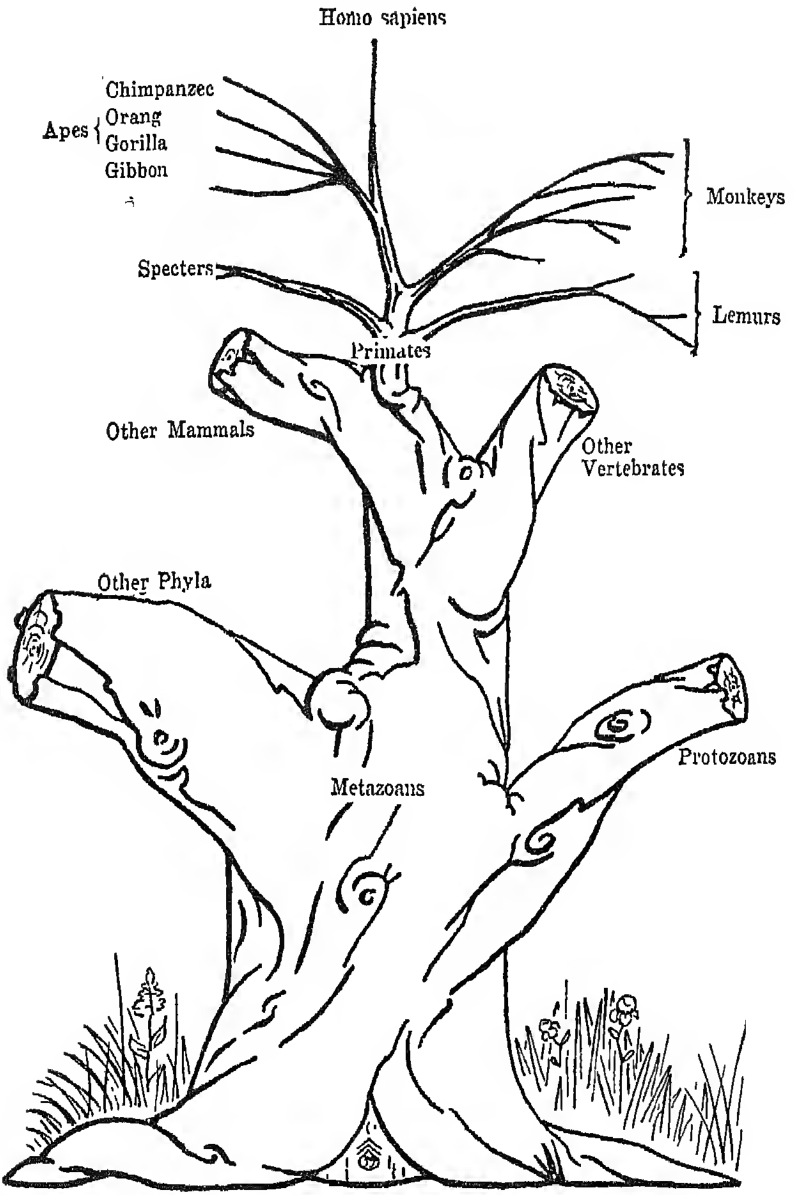
[6] Karl Linnaeus, the "Father of Systematic Zoology," who in 1735 first listed all the then known living animals and gave to each a scientific name. He placed man at the head of his list. He naturally gave to his own species a goodly name: *Homo sapiens* (Man, the knowing one, the wise). What kind of name our species might have borne if the donkey or the ox had done the naming we cannot say, but it doubtless would have been less flattering.

A CLASSIFICATION OF ANIMALS

Phyla	*Classes*	*Orders*	*Families*	*Genera*	*Species*
VERTEBRATA	MAMMALIA	PRIMATES	HOMINIDAE	HOMO	SAPIENS
MOLLUSCA* clams, snails, squids, etc.	AVES birds only	UNGULATA hoofed mammals	SIMIIDAE tailless apes	HOMO	neanderthalensis**
ARTHROPODA insects, spiders, crustaceans, etc.	REPTILIA lizards, snakes, turtles, etc.	CARNIVORA beasts of prey	CERCOPITHECIDAE macacus monkeys, etc.	EOANTHROPUS	dawsoni** the Dawn-man
ANNULATA earthworms, leeches, etc.	AMPHIBIA salamanders, frogs, etc.	RODENTIA squirrels, beavers, etc.	LEMURIDAE lemurs, galago, etc.	PITHECANTHROPUS	erectus** the Ape-man from Java
PROTOZOA amoeba, paramoecium, etc.	PISCES fishes, sharks, etc.	CETACEA whales, porpoises, etc.	TARSIIDAE the specters		
AND OTHERS	AND OTHERS	AND OTHERS		AND OTHERS	

* For further analysis of any of the lower groups see any textbook of zoology.
** Fossil; to be noted again in Chapter III.

Next, a genealogic tree (pruned down to the one branch that we are here considering) shows man's place in the animal kingdom more graphically.



THE SCRAGGLY TREE OF ANIMAL LIFE
pruned of all its branches save the one representing the order Primates.

Chapter II

THE PRIMATES

Thinking of man from the zoological viewpoint necessitates that we should know something about his nearest allies, the Primates. Let us stand a few of them up in line and look them over. Perhaps we may be able to see in them some interesting human pecularities. As indicated in the table on page 18, the primates comprise one of the orders of vertebrate animals. The more obvious distinguishing characters of the order are:

Hands fitted for grasping (and feet as well, except in man).

Fingers and toes armed with nails, instead of claws or hoofs as they are in other vertebrates.

Collarbone well developed.

Two pectoral mammae.

An unusually large upper brain.

This last character, though merely relative, is the most important of all. In the doings of that big brain, we of the human species take special pride. Perhaps we may need to learn something of its limitations.

A simple classification of the order Primates that is adequate for the purposes of this book divides it into four major groups as follows.

1. Lemuroids; the lemurs of the old world tropics.
2. Tarsioids; the specters of the Indo-Malayan region.
3. Anthropoids; monkeys and apes.
4. Man alone.

The lemurs, whose homeland is Madagascar and adjacent Africa, would hardly be taken for human allies on superficial acquaintance, for they are furry quadrupeds that run on all fours. They are arboreal and nocturnal in their habits. Their eyes are directed laterally. They have fox-like faces and strong canine teeth. The upper front teeth (incisors) are two pairs that stand well apart on the middle line. The lower incisors project straight forward (and are used, it is said, for combing the fur). Four of the toes and all of the fingers bear nails, but the second toe is armed with a sharp curved claw that is used as a nut-pick and as an instrument for extracting grubs from their burrows for food. The Lemuroids number, according to Elliott,[1] about 100 species. The grouping of the lemurs with the Primates is based on internal anatomical characters, and not on external appearance.

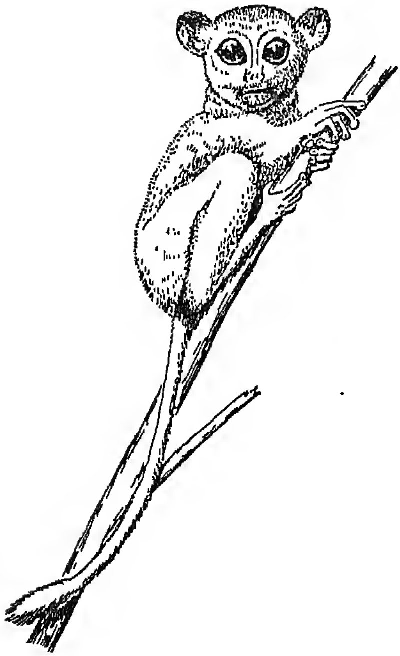
A ring-tailed lemur.

The specters are even less man-like in appearance. They are agile little fellows, not bigger than a rat, that hop about on long hind feet and cling to the smooth trunks in bamboo thickets by means of large sucking discs under the tips of their fingers and toes. They have big staring eyes that are directed forward for binocular vision,

[1] Elliott, D. G., in *Review of the Primates*, 2 vols., New York.

as in the higher primates. The eye socket is a cup of bone as in our own skull, and not a mere rim around its outer margin as in the lemurs, and in most other mammals. The snout is short.

Specters sit in a semi-erect position and use the hands for feeding as well as for locomotion. They are all arboreal and nocturnal in their habits. Seven species only are listed by Elliott, all from the Malay peninsula and adjacent East Indian islands and Mindanao.



A specter (*Tarsius*).

We now come to the Anthropoids, the monkeys and apes. To their characteristics we do well to give more heed, for they will often be referred to in the following chapters of this book. The anthropoids bear unmistakable likeness to man in form and in action. Their cages in the zoo are always thronged with interested spectators, some of whom are merely amused, some abashed,[2] and some perhaps offended.[3]

[2] It was Captain Rey of a French merchantman who wrote concerning a Malayan monkey encountered in one of his voyages, "The similarity of this creature to man is singularly mortifying."

[3] "It might be fancied that Satan had perpetrated monkeys with the malicious purpose of parodying the Masterpiece of Creation."—Nathaniel Hawthorne in *English Notebook.*

The monkeys are a host, numbering according to Elliott, some 400 species, and inhabiting the tropics of the whole world. They are commonly arranged in two groups as follows:

A. New World monkeys: marmosets, spider monkeys, capuchins and howlers, together with a few odds and ends of monkeydom, called sakis, sapajous, etc.

B. Old World monkeys: langurs, colobus monkeys, macaques, baboons, etc.

A few words about the New World monkeys will suffice, for they are not in our own primate line: they are our very distant cousins, so to speak. They are perhaps best known to the public for their remarkable tails: *prehensile* tails; tails that can grasp things; tails by which they can hang from a bar in the top of a cage. Since a few of them lack this special gift for grabbing, we may find another recognition character that will distinguish them from the Old World monkeys in the thick nasal septum that keeps the nostrils wide apart.

Elliott lists 155 species of New World Monkeys, many of them very small, but ranging in size from six inches to two feet in length of body. All are arboreal. They are distributed from southern Mexico to Patagonia. There are four groups of them that everyone should know.

1. The marmosets are among the smallest and most primitive of monkeys; soft furry tree-top dwellers, with nude faces and bushy non-prehensile tails. Their nails are curved and more or less claw-like, excepting the one on the big toe, which is flat. The thumb parallels the long fingers in grasping, but the big toe is opposable to the other toes.

Marmosets live in troops in the forests. They feed mainly on fruits and insects. They are soft as kittens and make good pets. They are easily tamed and they are much appreciated in the households of the natives in the American tropics.

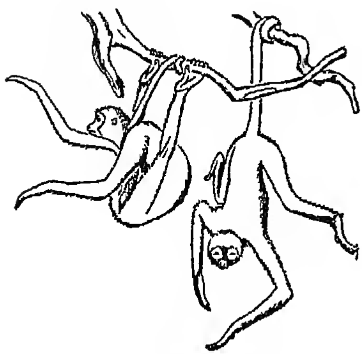

Marmosets.

2. Spider monkeys are among the best known of the anthropoids, for they live well in captivity and are found in every zoo. They are the world's champion acrobats, always performing, to the unending delight of the spectators outside their cages. They are slender and agile. The long arms and the legs and the tail are equally available for grasping. They spring gleefully about their cages and hang by their tails, and chase one another in play. Head up or down, any position seems to be a comfortable position for a spider monkey. They make very interesting pets, but because of their boundless curiosity, mischievousness, and energy they are difficult to restrain.

The fingers are long and hooked, and the thumb is rudimentary, but the big toe is well developed for grasping. The prehensile tail reaches its perfect development in this group, where it has become the equivalent of a fifth hand. Its tip is flattened and curved, bare and naked, and very sensitive on the concave, palm-like side. It can be

turned in any direction to grasp objects by enwrapping them. It can be used for conveying food to the mouth. Clasped about the branch of a tree it easily supports the weight of the body.

Spider monkeys feed mainly on fruits. They dwell in the lowland forests of tropical America, where the flooding of the land often keeps them up in the trees. They represent remarkable fitness in Primate adaptation to arboreal life.



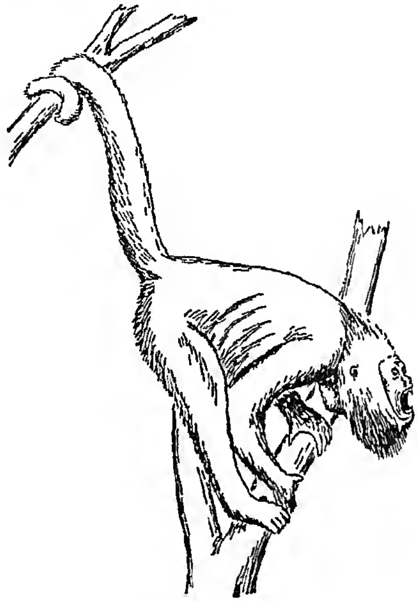
Spider monkeys.

3. The howler monkeys must be seen and *heard* in their native wilds to be appreciated. They do not take kindly to life in the zoo, and when placed in cages they remain inactive and silent most of the time. They are said to be untameable.

Howlers are among the largest of the American monkeys. They are stockily built, and have stout prehensile tails. Old males have a goiterous-looking throat, owing to the development inside it of an apparatus for making a most terrifying noise. The larynx is enlarged, and adjacent to it the hyoid bone is swollen and excavated to form a resonance chamber. The lower angle of the jaw is expanded downward as if to protect this precious musical instrument. When howlers howl in concert, the thunderous noise produced is appalling.[4] It makes the

[4] No words can convey the effect of it, but perhaps the best attempt at its description is to be found in W. H. Hudson's novel, *Green Mansions.*

forest resound, and it may be heard for miles. Howler monkeys wander through the forest crowns in companies. They feed mainly on fruits and foliage.



A red howler monkey.

4. The capuchin or cebus monkeys are sometimes seen in city streets accompanying the organ grinder and collecting pennies for him. They are easily tamed and take kindly to captivity and to human associates.

Their heads are round, their snouts are short and they have prominent canine teeth. Their tails are somewhat prehensile. They are truly four-handed: both thumbs and big toes are used in grasping. Their faces seem pensive and mischievous by turns, and their bright little eyes betoken a considerable degree of intelligence.

In the high forests of Patagonia there lives a weeper

capuchin that expresses its feeling by laughing and crying. When pleased it draws back the corners of its mouth in an unmistakable smile, and when its feelings are injured it may shed copious tears. So, after all, man is not the only animal that weeps.

We now come to the Old World monkeys (see figures on pages 19 and 38), the Primates that are more like us. These have non-prehensile tails, and thin nasal septa that allow their nostrils to come close together. They also have seat pads.[5] Elliott lists 285 species of these monkeys. They are somewhat larger than the New World monkeys, the range being from one to three feet in length of body. They inhabit the tropical mainlands and the larger islands of the Eastern hemisphere. A few species have entered the temperate zones. We shall have space here for mention of but a few of the better known examples of this vast assemblage of species. (See the figures on the left-hand side of the full-page diagram at the end of this chapter.)

First there are the langurs of India and the colobus monkeys of Central Africa, tree top monkeys that are mainly slender and agile and have long tails. They are all arboreal and herbivorous. They have small seat pads, their hands are slender, and thumb is reduced in size or altogether wanting. They have multiple stomachs of which the first compartment is a receptacle for food stor-

[5] These bare patches of leathery skin are also known by the more dignified name of *ischial callosities*, because they cover the lower prominences of the ischial bones of the pelvic girdle at the two places where trousers first need patching. Many a small boy when laid across the paternal knee has had occasion to regret the lack of these useful primate appurtenances.

age. It is reminiscent of the rumen of cattle, and serves a like purpose, allowing the animal to browse in the open in haste, and later finish its cud in a place of greater safety at leisure.

The entellus monkey, or Hanuman, the sacred monkey of India, is perhaps the most famous of the langurs. It has long been regarded by the Hindus as a god among their gods. The souls of the faithful have been believed to pass into the entellus by transmigration. Temples were erected in its honor. Hospitals have been built and endowed for the care of its sick, and the penalty for killing one has been death. Yet in India, in times of famine, these monkeys are at times direct competitors with the poor for food. They ravage gardens and even enter houses and rob tables in a very daring and troublesome manner.

The colobus monkeys of the great equatorial forests in Africa are well known for the fine quality of their long, silky, black and white fur. Civilized ladies of fashion wear it for ornament, and clouted warriors in the jungle wear it for prowess, and both wear it for the distinction it confers.

The macacus monkeys are familiar to all visitors to the zoo. They are probably most numerous of all monkeys in captivity, for they thrive with proper care and feeding and are nowadays raised in large numbers at research laboratories for use in physiological and medical experimentation. They are stouter of body than the langurs, with shorter tails and larger seat pads. The thumb is well developed. There is no antechamber for food storage in the stomach, but they have a partial equivalent in their capacious cheek pouches.

There is one tailless monkey, the so-called "Barbary ape." It inhabits a coastal strip of north Africa and enters Europe only at the rock of Gibraltar, where there is now a protected colony. This monkey has a place in the history of zoology, for it once served as a substitute for the cadaver, in the days when the dissection of the human body was forbidden by law. Much that the early anatomists knew of the structure of the human body was learned by inference from what they saw in this near-human primate.

The baboons run on the ground. They inhabit the bare, dry, and rocky hills and the thinly tree-clad wastes of Arabia and Africa. They are quadrupeds, going on all fours, walking on the palms of their hands and the soles of their feet. Their faces are long, with a dog-like muzzle and strong canine teeth. The teeth are sharp-edged, formidable weapons. The bare faces of some of them (mandrils) are grotesquely wrinkled and many-hued. The seat pads are very large—sometimes enormous, covering the buttocks, and often highly colored.

Baboons are largely carnivorous in feeding habits, eating such things as lizards, scorpions and insects. They live in herds, and have something of social organization.[6] This we shall have occasion to recall in the chapters of Part II.

[6] F. W. Fitzsimons published many observations on the social habits of baboons in two excellent works: *The Natural History of South Africa*, Vol. I, Mammals; and *The Monkey-folk of South Africa*. From the former (page 52) I quote:

"I saw a splendid fight put up by a warrior baboon. He was overtaken by a number of dogs. He might easily have escaped with the troop, but the fine old fellow, thinking the youngsters were in danger of being overtaken by the dogs before they could gain a place of safety, turned and engaged the

THE APES

The great apes are our nearest zoological allies. Of these there are four types: gibbons, orang, chimpanzees and gorillas. All are tailless and chinless and have arms longer than their legs.

1. The gibbons are tree-top apes, light in weight (fifteen to twenty pounds), slender in stature, excessively long armed and short legged. When standing fully erect their fingers rest on the ground. They belong in the forest crowns where they travel about with great ease, hand over hand, swinging from bough to bough. They make astonishing leaps through the air using only their long strong arms, their short weak legs being drawn up close to the body. The feet, however, have their uses in clambering about among the branches, and in grasping food. The gibbons compete with the spider monkeys for acrobatic primacy.

Gibbons have very small seat pads. Fur thickly clothes the whole body, envelopes the ears, and covers the forehead down to the frontal ridges above the eyes. The head is round and the nose flat. The jaws are not very

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dogs in combat. A greyhound in advance of the rest attacked him and was killed within a moment or two. When we arrived the baboon was facing the howling pack of dogs with his back to a bit of rock, and the lines,

'Come one, come all, this rock shall fly
From its firm base as soon as I.'

immediately occurred to me.

"Did I shoot him? No, a thousand times no. I stoned off the dogs and left him in peace. In my rambles over mountain veld and in forest I have met with more examples of the truest heroism and absolute self-sacrifice amongst the lower animals than I have with the higher animal known as man."

prominent, but they bear strongly projecting canine teeth. The fingers are long and slender. They bear highly arched nails that are reminiscent of claws, but the opposable thumb bears a flat nail.

When on the ground, gibbons stand more nearly erect than any of the other apes, but they stand unsteadily, using the extended arms for balancing, or lowering them until the knuckles rest on the ground for additional support. Walking is not their gait. They travel safely and speedily by swinging beneath the boughs of the forest cover but weakly and perilously on the ground. They roost in trees like monkeys, making no nests or perches or shelters of any sort.

Gibbons inhabit the Malay peninsula and adjacent islands. While more like man in roundness of head and in erectness of standing posture than are any of the other apes, they are less like him in other characteristics, including that most important one—development of the brain.

The other apes differ from the gibbons in being clothed with hair and not with fur, and in lacking seat pads.

2. The orang is a much larger ape whose native home is in the forests of Sumatra and Borneo. It is a bulky beast with barrel-shaped chest, small buttocks and a roundly bulging belly. Although weighing as much as a man, its height when standing is not over four feet, owing to the shortness of its legs.

The orang's head is large, but mostly runs to jaws, whose prominence is further extended by very thick lips. The brow ridges are low. The flat nose is so small as to

be an almost negligible feature of the face.[7] The large canine teeth are interlocking. A middorsal ridge along the top of the skull serves for the attachment of the powerful jaw muscles, and a transverse ridge across the occiput, for those that hold up the head. The tight little ears are bare, as is the low forehead. The hair is red, a brownish brick red.

The old male orang develops blinker-like folds of skin before the ears, framing the face and these folds run down into a brush of luxuriant red chin whiskers. Thus in his prime he acquires an altogether curious and impressive aspect.

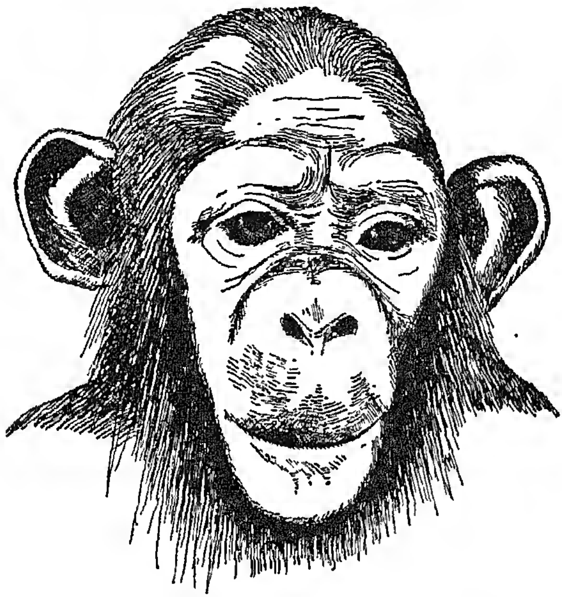
3. The chimpanzee is perhaps the most interesting of the apes. Judged by what it may be taught, it has the best brain. It is a more shapely beast than the orang, with shorter legs and black hair. In weight it equals our own species, but in height it rarely exceeds five feet.

The chimpanzee is less strictly arboreal than the orang. It spends more of its time on the ground. It walks with a forty-five degree stoop, applying the knuckles of its long fingers to the ground for support as it goes. It walks on the outer edge of its foot, with the big toe lifted from the ground. Both foot and hand are well developed for grasping. The thumb is very short. It reaches only to the level of the first joint of the index finger, but it is easily opposable.

The dome of the chimpanzee's head rises roundly between a pair of large outstanding ears, and a rather fine

[7] Orang physiognomy will be recognized in the face of Mr. Jiggs of the famous American cartoon series entitled "Bringing up Father."

forehead surmounts a pair of bright, deeply set, intelligent eyes. The little snub nose occupies but a small part of the space between the forehead and the ample mouth. The mouth is tight-lipped, and the canine teeth are smaller



Portrait of a chimpanzee (drawn from a photograph).

than the orang's. The face is naked, but in the male it is bordered by "sideburns" before the ears, and these run down into a thin beard beneath the chin.

4. The gorilla is the largest of the Primates The average weight of adult males is probably not less than 300 pounds, and the height not less than six feet. When standing erect the hands fall below the level of the knees. The arms are a fifth longer than the legs. The feet are less adapted for grasping boughs than those of other apes, and better fitted for walking on the ground, with a larger

heel and a flatter sole; but the big toe is opposable to the others, and quite capable of grasping.

The long hair is black. It partly covers the rather small ears and the low forehead, and is a more uniform coat than that of the chimpanzee. The head is massive, low in front, with beetling brows and very heavy jaws. The nose has at the base a suggestion of a bridge, and beyond the base nothing but wide-rimmed nostrils that open directly forward. The teeth are very large, especially the canines. All anthropoids fight with their teeth.

The order Primates is like most of the other orders of vertebrates in that it is composed of a few families that have fitted world conditions well and that have in consequence become numerically dominant (the families of the monkeys); a few dwarfs of rather primitive character, left-overs, so to speak, restricted to the less desirable niches of environment (the specters); and a few giant forms so large that the demands they make on the environment preclude their numerical increase (the great apes and man[8]).

Man has physical characteristics in common with each of the great apes and distinct from all the others. In roundness of head and erectness of standing posture the gibbon is more like him than are any of the others. The orang is like him in having twelve pairs of ribs, while the others have thirteen pairs. In form of hand and foot the gorilla is most like him, while in stature and in brain capacity and many minor characteristics the chimpanzee comes nearest of them all.

[8] Man in his primeval estate, before the development of agriculture.

Man differs from them all[9] in having a bridge to the nose; in having the lips outrolled, exposing the mucous membrane of the lining of the mouth; in having a median furrow down the upper lip; in having a pendent lobe at the bottom of the ear; in having a nearly hairless body, with such hair as remains better developed on the ventral than on the dorsal side; in having a longer big toe; in having a better foot with more perfect arch for supporting his weight; and in other minor characteristics, not to repeat the major ones already mentioned on page 14. Of the latter the bigger brain and the freer hand are by far the most important.

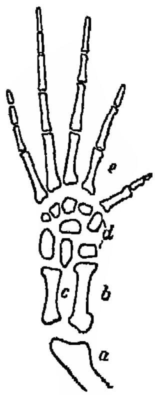
These structural and developmental likenesses do not show that man is descended directly from any of the present-day Primates, but they do show that he is related by ancestry to them all. The "missing link," half-way between man and ape, is a myth; the connection is not between, but behind. Men and apes have followed different lines of specialization, the apes becoming more apish and men more human as time has run. That these routes converge backward toward a common point of origin in the past seems very evident.

Convergence appears clearly in their individual development. Men and apes are most alike in infancy and grow unlike as they grow to maturity.

Man is in many respects a rather primitive vertebrate. His hand is very like the hand of a salamander. Its bony

[9] Plato having defined man to be a two-legged animal without feathers, Diogenes plucked a cock and brought it in to the Academy, and said, "This is Plato's man." On which account, this addition was made to the definition,—"with broad flat nails."—Laertius in *Life of Diogenes.*

skeleton is more of the typical vertebrate pattern than is the thumbless hand of a colobus monkey, specialized for climbing. This primitiveness has had its advantages. A hand so *specialized as the front foot of a* horse or the wing of a bird could do but one thing. A generalized hand could be put to many uses.

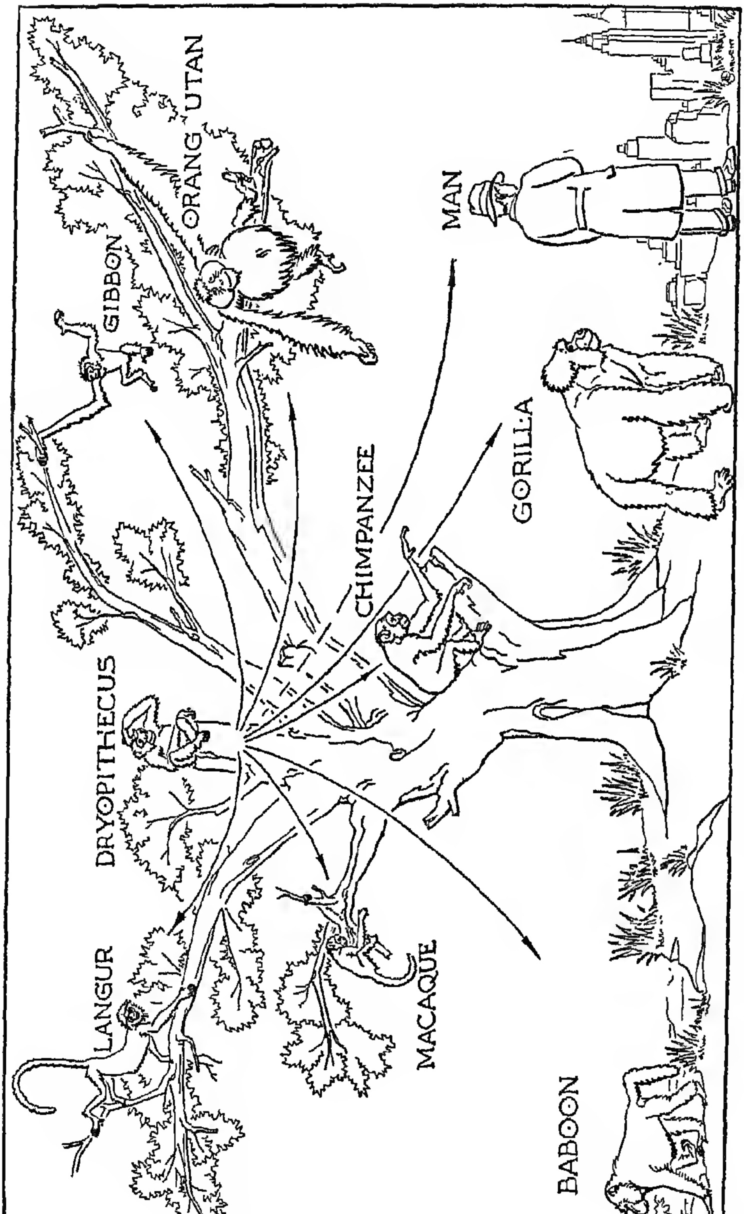


The skeleton of the hand (front foot) of a salamander.

There are well known fossil remains of Primates that lived in former times and in general they are more primitive than the living ones. One that has been much discussed is Dryopithecus, a tree ape that lived in Miocene times. Its bones show it to have been arboreal, with a small brain and moderately prominent jaws; its teeth were rather small and the arch of its lower jaw was rather wide, allowing room for free movement of the tongue.

Dryopithecus appears to have been a middle-of-the-road anthropoid, having in a simple form some of the characters that are common to all the now existing higher members of the group, characters thus possibly ancestral. The accompanying picture is intended crudely to represent the main lines of anthropoidal specialization. Starting with Dryopithecus as the central (ancestral) figure, the outgoing lines run two ways; the monkeys are on one side and the apes on the other; their specialization has run somewhat parallel. The langurs and the gibbons went to the tree tops. The baboons and the gorillas went to the ground. (See page 38.)

Homo went to the ground; got up on his hind legs; quit using his big toe for grasping; found new uses for his hands; took to wearing clothes; lost most of his hair; tried getting educated, getting intoxicated, getting vaccinated, getting matriculated, and doing other things quite foreign to the zoological realm.



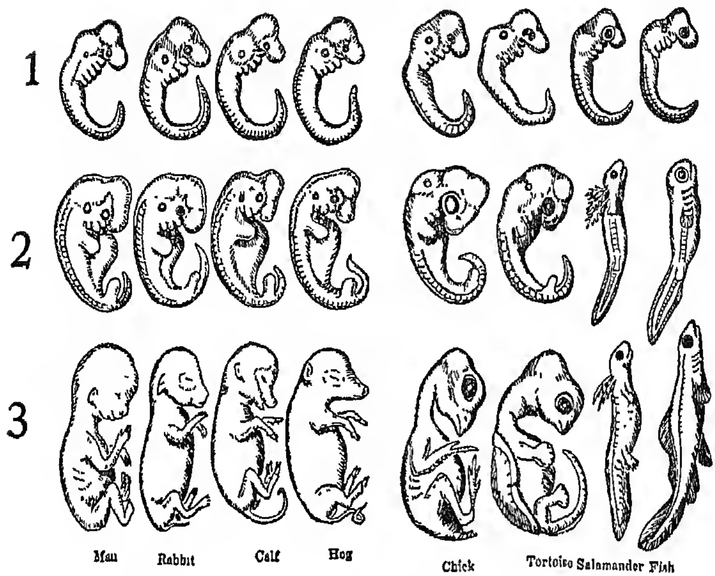
Principal lines of specialization among the higher (Old World) Primates.

Chapter III

MAN'S REMOTE ANCESTRY

In the two preceding chapters we have seen how much of his physical make-up man has in common with other animals, and how little he has that is distinctive. It is perfectly evident that he is a Vertebrate, a Mammal, a Primate, so like the others that in a zoological classification he may be removed only to a separate family, Hominidae. We have grouped the primates in an ascending series of families with the Lemuridae at the bottom and the Hominidae at the top, the likenesses to man increasing in specters and monkeys and apes as we ascend, and we have seen that their embryonic development reveals greater likeness in their earlier than in their later stages. The lines converge backward pointing to a common origin in the remote past. We shall have occasion to return to this matter in a later chapter, but we may here copy by way of illustration Haeckel's classical figure of the later stages of development in the five classes of vertebrates, including three orders of mammals, the order of the Primates being represented by *Homo sapiens*.

Man and ape are very much more alike in infancy than in adult life. They diverge during development, one becoming more apish, the other more human as they ap-



Vertebrate embryos: 1, 2, 3, successive stages in their development. (After Haeckel.)

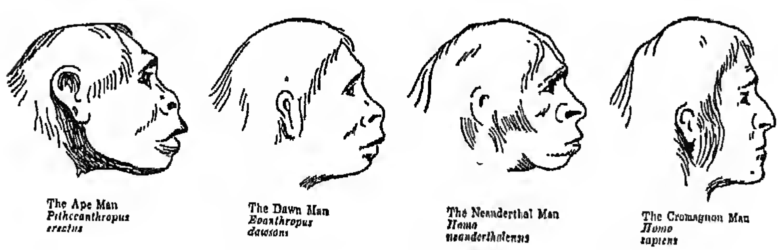
proach maturity. Clearly this does not indicate that man has sprung directly from some ancestral ape, but that both have developed from a common progenitor that lacked their several peculiarities. Thus as in all animals, the successive phases in the development of the individual seem to give us evanescent glimpses of its past, its phylotic history.

he actual record of the past is the fossil record. It sts of the remains of animals buried in the crust of arth. It is, of necessity, very incomplete, for brain nuscle and all other soft parts disappear and leave no . Only the hard parts are preserved as fossils. These ach parts as the shells of molluscs, the wing veins of ts and the bones and teeth of vertebrates.

Hard parts are dead parts; yet they are the permanent defenses and supports that in every group are fashioned in accordance with needs and hereditary tendencies. Every group builds these parts on architectural lines that are peculiar to itself alone. The elements of the structural plan are so correlated that from fragments the form and size of missing parts may be inferred. Bones tell of the muscles that once covered them; the evidence is in the ridges they bear for muscle attachment. Teeth tell of the jaws that they once armed by the size, form, number and strength of their roots.

So when the palaeontologist studies fossil fragments they arrange themselves in his mind in harmonious relations. The bones tend to reclothe themselves with muscles whose size is proportioned to that of their attachment surfaces; the jaws grow to fit the teeth; and when this mental picture is drawn on paper we call it a restoration.

A considerable number of fossils have been found that students of primate anatomy agree are the remains of primitive members of the zoological family Hominidae. Restorations have been drawn and widely published. The public has had opportunity to become familiar with the hypothetical features of the four fossil men shown in the



The four most famous of our remote ancestors. (After Gregory.)

classical figures that we copy herewith. Two of these, the ape-man, *Pithecanthropus erectus*, and the dawn man, *Eoanthropus dawsoni*, are sufficiently different from us in structure to be placed in separate genera, while the other two are placed along with ourselves in the genus *Homo*. The latter two seem to differ from each other only as species may differ from one another.

There has been great activity in the search for human fossils in recent years, and at least two more genera of the family Hominidae have been described from fossil fragments: *Sinanthropus* from China, and *Australopithecus* from Bechuanaland in Africa; and further discoveries may be expected as the search proceeds. It is quite beyond the scope of this book to discuss these forms, and quite unnecessary, since excellent descriptions and figures are elsewhere available.[1] May it suffice here if we pause merely to point out in one of the most primitive of these lowly hominoids, *Pithecanthropus erectus*, a few of the characters that indicate its intermediate position between the great apes and man.

This Javan ape-man is known from a few fossil fragments; those first found were the top of a skull, a thighbone, part of a lower jaw, and three teeth. The thighbone is relatively long and straight, and a well-developed longitudinal ridge on it (a ridge that serves for the attachment of the large extensor muscle of the thigh) indicates that Pithecanthropus walked erect, as his specific name indicates. This ridge is much less developed in the apes,

[1] Osborn, H. F. *Men of the Old Stone Age*, New York, 1915.
Keith, Arthur. *The Antiquity of Man*, London, 1921.
Burkitt, M. C. *The Old Stone Age*, Cambridge, 1933.

much more developed in us. The teeth also, though large, are more like human teeth. One is a canine tooth, and it is not tusk-like; the portion of the jaw that bears it is not enlarged as in apes, but is more of the proportions found in man. The jawbone also indicates that the wisdom teeth were somewhat reduced in size.[2]

The walls of the cranium are thicker than in man but not so thick relatively as in apes. On their inner surface are indications that the frontal lobe of the brain was better developed than in the apes, with a distinguishable convolution near its lower border where lies the center for control of speech.

Enough of the cranium is preserved to furnish a basis for estimate of the size of the brain. The cranial capacity has been calculated to be approximately 900 cubic centimetres, whereas that of the apes ranges between 210 and 290 cc., and that of *Homo sapiens* generally between 1200 and 1500 cc. The frontal ridges are higher than in man and the forehead is less prominent. At the back of the head the cross ridge that serves for the attachment of neck muscles is much more strongly developed. This indicates that the head was set upon the neck vertebrae in a more or less ape-like fashion. Evidently *Pithecanthropus* was a low-browed thick-head, as Dr. McGregor's restoration indicates. He is estimated to have been about five feet eight inches in height and to have weighed about one hundred and fifty-four pounds.

It is fortunate that the brain case long resists decay.

[2] Human teeth differ from all others, but the slight differences of form in cusps and crowns require a most exacting and detailed knowledge of primate dentition for their interpretation.

It alone preserves for us the fossil record of past brain development. The series of restorations pictured on page 41 shows this increase in cranial capacity: *Pithecanthropus erectus,* 900 cc.; *Eoanthropus dawsoni,* 1620 cc.; *Homo neanderthalensis,* 1408 cc.; *Homo sapiens,* 1200 to 1500 (exceptionally, to 1900) cc. While the facial appearance of these fossils as shown in these restorations is, of course, hypothetical, the estimates of the size of the brain are based on very careful measurements, and the marked increase in cranial capacity is beyond question.

There is evidence also of a correspondingly progressive increase in man's capacity for taking thought. It is found in the tools and other relics that are preserved along with the fossils. Buried in the gravels with the bones of the dawn man are the crude flints that he used as tools or as weapons. They are not mere rough stones, such as one might find in nature already shaped to the hand. They are stones shaped by mechanical flaking, and by chipping. These processes yield edges suited to cutting and scraping. Doubtless he had other implements and wares, made of softer materials such as wood or fiber, but these have perished with him, and only the flints remain.

The use of these flints, crude as they were, marked an epoch in the history of civilization. Here was a departure from the behavior of the ape, who never learned to use a tool, who never even attained to the simple idea of crushing the skull of an enemy by means of a rock in the hand. Apes never supplement nails and teeth with implements of wood and stone.

The Neanderthaler made tools of flint better than

those of the dawn man, tools more shapely and in greater variety, adapted to different uses. His flints show a finer workmanship in their chipping. He lived in cave entrances and in rock shelters, and he knew the use of fire. Along with the ashes of his fires there are preserved charred remnants of his feasts. The extinct cave bear and the mammoth were his contemporaries, the former being his competitor for such shelter as caves afforded.

The objects of his home environment were such as bestrew the lair of the wild beast in similar situations—chiefly things left over from his feasts, the most imperishable of these being the bones of his victims. Among these are human bones, split ingeniously for the extraction of the marrow—probably a choice morsel in his diet.

It is not an attractive picture of the life he lived that these facts suggest. It differed from that of the cave-dwelling beasts chiefly in the use he made of tools and of fire. There is promise of later attainment in the finer workmanship bestowed upon his tools. There is evidence of a higher range of thinking in the way in which he buried his dead. At least one Neanderthal skeleton (that from the cave of La Chapelle-aux-Saints) seems to have had a ceremonial interment, for it was protected where it lay and accompanied by tools and by the bones from joints of meat; which things suggest thoughts of a life beyond the grave.

Written history goes back only a few thousand years, but the records of archaeology go back at least half a million years further. We cannot here take up their fascinating story as it appears in the fossil remains of the

Cro-Magnons and in others of later date: the improvement and diversification in tools of flint and wood and bone during the stone age (when the use of metals was as yet unknown); the development of spear and shield, of bow and arrows, of implements of labor, and of articles for personal adornment; the beginnings of artistic expression. Nor can we even mention the vast changes in material equipment during the succeeding ages of bronze and of iron. No written account of these records of human progress can be equal to a thoughtful visit to any good museum of antiquities, in which the archaeological exhibits are arranged in their evolutionary sequence. These tell the long story of our cultural evolution.

Brain is the chiefest of the gifts of the gods to our species. In the next two chapters we shall consider briefly what zoology has to say about how we came by it.

Chapter IV

THE DEVELOPMENT OF THE NERVOUS SYSTEM

The most peculiar thing about man is his behavior. This is dependent upon a responsive mechanism consisting of a nervous system and sense organs, connected with the muscles and glands that act in response to stimulation. The chief thing determining the range and character of man's activities is the nervous system; so let us ask what zoology teaches as to its origin.

The nervous system is a very complicated thing. We shall not attempt to describe it here, but only to point out some general features of its organization that may help us to understand how it serves as a regulatory mechanism among the organs within the body, and how it maintains adjustments to conditions in the world outside. We will follow the zoologist's method, and compare together a few animals as to their nervous equipment, beginning with the simplest. In order to understand any complex thing, it is best first to seek out its simplest expression.

Looking backward down the grade of animal organization we see amoeba at the foot of the scale. This little animal is hardly more than a microscopic bit of protoplasm, transparent, colorless, shapeless, consisting of a

single cell, with only the usual cell parts, nucleus and protoplasm, represented. The one thing in its body that shows any permanence of form is the nucleus. When in action, the body is continually changing shape. It contracts into a spherical droplet when disturbed. Becoming active again, it extends itself and pushes out some of its soft substance in a few bluntly rounded projections called *pseudopodia* (false feet). It glides along from place to place very slowly and with a rolling motion of its protoplasm.

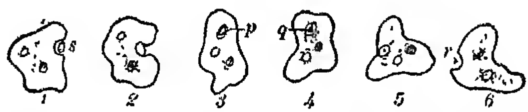


Diagram illustrating the feeding of amoeba: 1, 2, 3, the food intake; 4, 5, 6, removal of the indigestible residue; *s* is a one-celled food plant; *p*, the same recently taken in and occupying a food vacuole; *q*, the same partially digested; *r* residue of the same, discharged.

One may watch its behavior through the microscope; may see it move toward an object suitable for food, such as a diatom or other minute plant cell; may see it slowly wrap its body about this object, enfolding, then engulfing it, and then more slowly digesting it; and if there be any

Diagram of the avoidance reaction of amoeba: *a*, in the position when stimulated by a glass point; *b*, its reaction: arrows indicate the direction of flow of the protoplasm. (After Jennings.)

indigestible residue, later one may see this residue cast out and left behind. Amoeba will recoil from the prick of a needle; it will draw away from contact with an irritant, such as a solution of quinine. In these actions it shows capacity for making reactions of two types, *attractions*

and *avoidances,* the two basic types into which most of the activities of all animals are resolvable.

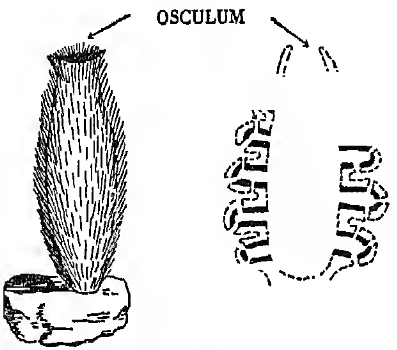
The amoeba has no brain, no nerves, no sense organs, no muscles and no glands. It feels without nerves, digests without a stomach, breathes without lungs, and even gets along without a heart. It performs all animal functions without any permanent organs. It might have been designed to show the world what is basic and necessary in animal organization as distinguished from what is merely accessory. Its capacities are those of protoplasm. The amoeba is a paragon of simplicity. It has become in our language a convenient symbol for things primitive.

There are other one-celled animals that are not so simple in structure. Some have permanent form of body, with definite front and rear ends, specialized swimming and feeding apparatus, parts of special sensitivity and other parts that are contractile; but these developments, being limited to the confines and resources of a single cell, need not concern us here. Ours is a different line of development.

FIRST STEPS UP THE GRADE OF NERVOUS ORGANIZATION

Among multicellular animals the foreshadowing of nerve and muscle is first seen in some of the sponges. There is a common marine sponge called *Grantia* that is found in the shallow waters of our coasts. It looks very little like an animal at first glance for it does not seem to move. It has a vase-shaped or bag-shaped body, of variable form, a few inches long when grown, attached by its

base to a rock or other solid support. It is a bag of animal tissue, sustained on calcareous skeleton spicules that are embedded in its flesh. There is a single large opening, the osculum, at the summit of the body. The walls are truly "spongy," for they are penetrated by numberless minute canals that extend from pores on the outer surface of the inner cavity. Water currents enter these pores and are driven through the canals by the activities of some of the bordering cells. These currents flow into the internal cavity and out of it through the osculum. Food carried by the current is taken up by the cells along the way.



A simple marine sponge, *Grantia*, and a diagram of its plan of structure.

To the unaided eye only one part of the sponge shows activity, and that is the part immediately surrounding the osculum, the "neck." On disturbance the osculum and the inhalant pores close; left undisturbed a while, they slowly open again.

Embedded in the walls of this main passageway there is a ring or circular band of cells that have special contractility, and sensitiveness to stimulation. These cells are long, more or less spindle-shaped, close laid, and overlapping, with their long axes lying parallel in the direction of the band that they compose. When cells of such shape contract they are very much shortened. Ranged

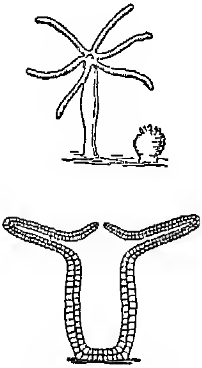
thus together, they act together, and on stimulation they close the osculum against intruders. A stimulus at any point on the rim of the osculum is instantly passed along the band from cell to cell. The cells stimulate each other. Few relays are needed because of their length. In them the functions of both nerve and muscle are combined, and hence they are called *neuro-muscular* cells. These foreshadow nerves and muscles.

NERVE AND MUSCLE

The two basic elements of a responsive mechanism, nerve and muscle, we find feebly differentiated in the fresh-water hydra. This is another legless (sessile) animal. It lives attached by the base of its tubular body to any solid support. At the free end of the tube is the mouth, surrounded by a circlet of five or six radiately swaying arm-like tentacles. These bring the food to the mouth. The body is a mere food sac; and the tentacles are similar slender saccular outgrowths from its walls. The walls of both body and tentacles are double. They are composed of an outer layer of cells called ectoderm and an inner layer called endoderm. The ectoderm is protective, and maintains relations with the outside world. The endoderm digests and takes up the food. Here is division of labor, with a low degree of differentiation of parts that have taken on separate functions.

The hydra is a far more sprightly animal than the stolid sponge. It erects its body and extends its long tentacles in search of food. But when touched it suddenly contracts to a globule of quivering flesh, with tightly

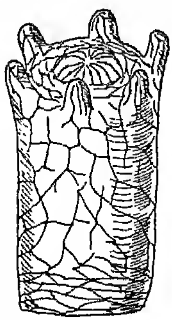
closed mouth and with the tentacles so closely indrawn that they appear as a ring of little buds around it. The contraction is instantaneous—too quick for the eye to follow—and it involves the whole body and the tentacles in one effective avoidance reaction.



Hydra, extended and contracted, and a diagram of its plan of structure.

Nerve and muscle are the agents of this heightened activity. Both appear in the hydra in a very primitive form. Within the body wall at the junction plane of its two layers, certain cells have developed underlying projections that have special contractility—muscular outgrowths. Other cells have developed longer, slenderer, threadlike, widely branching outgrowths and have become nerve cells. Their branches extend all over both body and tentacles. These irregular nerve cells, meeting by the tips of their branches, compose a nerve net.

The nerve cells are most numerous about the mouth and in the tentacles, and these parts are in consequence the



The nerve-net in a young hydra, with the nerve cells stained to show the arrangement of their fibres: openly spaced on the sides of the body, radiately arranged around the mouth and the tentacles and ringed around both ends.

most sensitive parts of the body. This network puts each part in sensory communication with every other part. A

stimulus applied at one point may be carried to all other points, enabling all parts to act in unison; but there is as yet no brain or other coordinating center.

To the same zoological class as the hydra (Class Coelenterata) belongs the sea anemone, Metridium, a marine animal of much larger size. It may be made the subject of simple experiments that will show something of how a nerve net works. This animal may be kept in a sea-water aquarium and fed on beef broth. If bits of blotting paper, saturated with the broth, be placed on a tentacle of the animal it will carry them to its mouth, swallow them, extract the food and later eject through its mouth the spent and indigestible paper. After it has been thus fed for a time, if a bit of blotting paper lacking the broth and containing only water be placed on a tentacle, the animal will at first swing this to its mouth, but will not swallow it; and after a number of repetitions, it will at once drop the paper without any feeding movement. Then if one continues by alternating bits with and without the broth, the animal will soon learn to distinguish between them and will act accordingly.

This, on one tentacle; but if an untried tentacle on the other side of the body be used, at first there will be no such discrimination in response; the empty paper will be carried to the mouth for a time as before. This shows how localized has been the effect of the experiment: shows that the animal has been educated on one side only, so to speak.

Furthermore let the experiment be tried again on the same tentacle after lapse of half a dozen hours without

feeding and the trials will run the same slow course as before, with no apparent gain from previous experience. Thus it appears that in the nerve net there is little capacity for correlation and still less for the retention of the results of experience.

We do well to remember that receptivity and action are older than nerve and muscle. These functions are too general and too important to be wholly committed, even in the highest animals, to any particular set of cells. It is only the more specialized activities that are taken over by nerve and muscle, and there remain other important needs in the body that are met by slower processes in which nerve and muscle take small part. Manifestly, before nerve and muscle were developed, interaction had to be brought about by contact between adjacent cells, as is still necessary during early embryonic life before nerve and muscle appear. The movement of a stimulus by slow passage from cell to cell is like the slow communication of news by word of mouth from door-yard to door-yard as compared with telegraphic dispatching. The old slow way persists; it is never wholly superseded.

When nerves develop they take over wholly the function of rapid communication between distant parts; but certain older and slower processes of bodily economy continue to be performed by older and slower methods. Cell still acts upon neighboring cell indirectly; and it also acts upon other cells of the body by contributing its products to the fluids that bathe the whole interior.

Certain organs in our own bodies (the endocrine glands: thyroid, adrenals, etc.) produce internal secre-

tions that are circulated about with the blood, and that profoundly affect the well-being of the body as a whole. These are a part of its self-regulating mechanism.

But we are here concerned with nerves; so let us next consider the make-up of the vertebrate nervous system.

THE VERTEBRATE PLAN

In vertebrate animals, there are still neuro-muscular tissues in the walls of the heart and the stomach. These most ancient of animal organs thus keep in part to old ways of doing things. And there is something of a tangle (plexus) of branching nerves at several points within the body cavity (the solar plexus, for example). But nerve cells of a higher type of development (*neurones*) are present in all vertebrate animals. They have attained to a longer outreach through the development of fibers that are unbranched and individually insulated through the greater part of their length. They are organized into a nervous system that is something more than a mere network of radiately branching fibers.

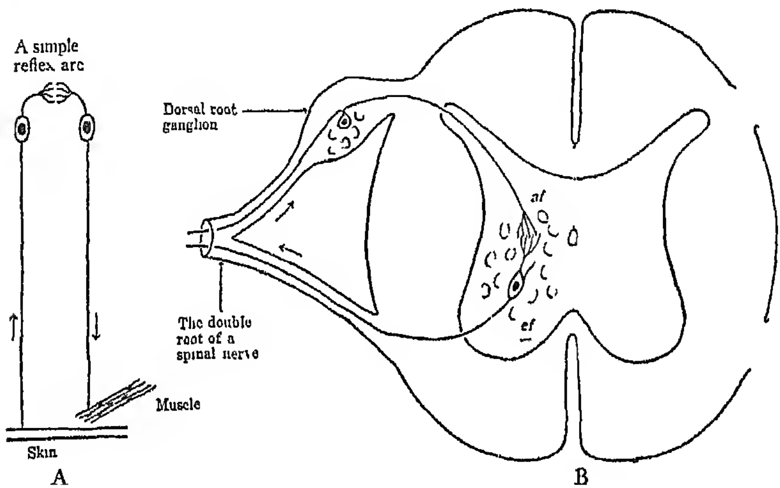
Reflex arcs[1] are the units of organization in the higher nervous system of the vertebrates. Each arc is a pair of complemental neurones in contact by the inner ends, together providing a nervous connection between some point on the outside of the body and some muscle or gland inside it.

In its simplest form a reflex arc is a mechanism by which a stimulus at one point on the skin may produce a

[1] So called because the effect of a stimulus sent over the pair is reflected back into view in the contraction of the muscle.

contraction in one muscle (see figure below). It is like the action of an electric house bell: a push on a button at the front door produces a ring on one bell in the house.

A definite channel for the transmission of nervous energy is provided in the nerve fiber. There is also a definite mechanism (the *synapse*) for the transfer of it from



Reflex arcs: A, a diagram; B, actual arrangement in the human spinal cord.

cell to cell. Where the terminals of two cells meet there is a spread of their apposed fibrils in a pattern that is suggestive of the lines of force in a magnetic field.

At *B* in our figure is shown the meeting of two nerve cells of a single reflex arc, such as is typical of vertebrates. The spinal cord is represented in cross section. At *af* is shown the inner end of the afferent or sensory member of the pair, whose cell body lies just outside the spinal cord in a dorsal root ganglion and whose receiving terminal (not shown) is in the skin. Every bit of the surface of the

body is reached by the sensory member of some such pair. At *ef* is shown the efferent or motor member of the pair, whose cell body lies in the gray matter of the interior of the spinal cord and whose fiber runs out to a muscle (not shown).

It is the primary function of nerve cells to join together all parts of the body in sensory communication. Some of them must be connected externally with the skin or sense organs, and some internally with the muscles, to the end that the sensing of conditions in the external world may bring about prompt and appropriate measures for dealing with these conditions. The possession of fibers made it possible that nerve cells should be removed from the surface, where they were first developed, into the interior of the body, where they are less exposed to injury. And in removal from the surface they have tended to become gathered together in groups, the simplest of which we know as *ganglia.*

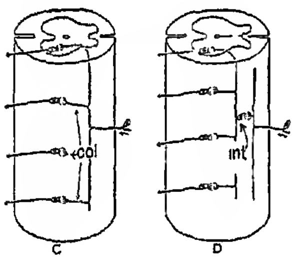
Ganglia are local centers that exercise a regulatory function within a limited portion of the body. Their number and arrangement differ according to the differences in structural plan of the animals to which they belong. In deeply segmented animals like the earthworm the ganglia are arranged segmentally in pairs, each ganglion pair controlling primarily its own segment. In vertebrates the massing of the nerve cell bodies is mainly in and adjacent to brain and spinal cord. Thus they are far removed from the surface of the body.

Nerve fibers are tied up in the bundles that we know as nerves, in which they are laid parallel, like the wires in

a cable, ensheathed in a protective covering. They spread apart only at their proper terminals. Our figure is therefore of but one element of a spinal nerve.

Each spinal nerve has two roots. The posterior root is a bundle of sensory fibers, the anterior root one of motor fibers. This disposition of functions is easily proved by cutting the roots one at a time. Cutting the dorsal root destroys the sensitiveness of the area in the skin to which the terminals of its fibers are disturbed; cutting the anterior one paralyzes the corresponding muscles.

There are no nerve paths quite so simple as the one shown in our diagram. There are always by-paths that a stimulus may take to reach other motor nerve cells and to produce multiple responses. These by-paths may be provided in the nerve centers in various ways, two of which are shown in the next diagram. Collateral branches (*col*) from the inner end of a sensory cell are shown within a short segment of the spinal cord, each with its own synapse connecting it with a different motor neurone. This is like the electrical connections in a house that allow a push on a single button at the door to ring simultaneously a number of bells in different places inside. It extends the range of stimulation considerably. Another plan that extends it much farther is that of intercalary cells within the nerve center, joining the arcs together. It also is shown diagrammatically in the figure (*int*).



The tie-up of reflex arcs.

The nervous system is a unit. No reflex arc exists by itself alone. All the circuits of the body are connected; in the first instance by collaterals and their terminal branchlets, and in the next, by the branches of intercalary cells located within the nerve centers; and the by-paths of possible communication between different parts of the system are inconceivably numerous.

The existence of a by-path does not mean that a nerve impulse must always follow it. There are main travelled roads as well as by-paths in the nervous system. A stimulus at any given point on the surface of the body has its accustomed path which it always follows. Whether it will overflow into possible by-paths is often determined by its intensity. For example, a finger prick if slight enough may merely cause the finger to be lifted in response. A more vigorous prick at the same point may cause the arm to be jerked back, involving the action of many muscles. A deep puncture may initiate nervous impulses vigorous enough to overflow into most of the motor circuits of the body, calling the whole muscular system into action. This may be likened by analogy to the distribution of stimulating news by telegraph. A slight accident excites but a little local interest among the few people who are directly involved, but a war scare may set the wires going in every telegraph office in the land. There is a mechanism at hand for communicating with all the motor circuits in the body, but only so much of it is used as is warranted by the nature of the stimulus.

Intercalary cells located in the nerve centers serve as intermediaries of communication between the associated

reflexes of local areas, giving them wider possible contacts, and thus vastly extending the field over which the effects of local stimulation may be distributed.

Thus far we have been dealing with the wiring, to so speak, of our bodily telegraphic system. In the next chapter we will consider how the lines are all brought together, organized and coordinated in a grand center of control. This will be the story of how we came by our brains.

CHAPTER V

THE DEVELOPMENT OF THE BRAIN

We continue with the vertebrate plan.

The network of reflex arcs distributed all over the surface of the body is the part of the vertebrate nervous system that makes contact with the outside world. In addition to this there is within the body an inner network of nerves, the autonomic nervous system. This system is more ancient and more primitive. It has its own centers for local control, and its own synapses throughout, automatically regulating the work of the organs in the body cavity. The operation of this complex of two vast systems of intercommunication requires a control center of a higher grade than that of scattered ganglia. So long as ganglia are of equal potency, the effect produced in one by a stimulus at one point on the body may be opposed by the effect produced by a stimulus at a distant point.[1]

Stimuli are not of equal importance, and their importance often is not proportioned to their intensity. A very slight vibratory stimulus in the form of light coming to the eye may reveal the near approach of a powerful enemy.

[1] For a trifling example: if a tickling sensation in the nose be impelling one to sneeze, he may, as a countervailing stimulus, apply pressure to the upper lip and thus keep from sneezing.

It is important that the animal heed and respond to this stimulus and make his escape, even though appealed to by tempting food at the same time. He must run now; he may eat at another time. In other words, it is often important that all the activities of the animal be concentrated on a single purpose, be it escape or defense; it may be a matter of life or death. Hence some part of the nervous system must dominate the other parts to the extent of determining what stimuli shall be heeded and toward what end all the activities of the body shall be directed. If there can be a headquarters to which all stimuli may be referred and from which all dominating impulses shall go out to the muscles, the resulting action will be more efficient.

To eat, or to run: that is the question. To which stimulus shall he respond, which impulse obey?

The mechanism for such unified control is the brain. It appears to have been developed out of the many cells that are situated as intermediaries between the peripheral reflex circuits. These intermediaries have developed secondary circuits of their own, within the central nervous

system, and have become the agents for assembling the effects of multiple stimulation.

A peripheral reflex arc is sensitive to but one kind of stimulus and tends of itself alone to give but one kind of response, but the secondary circuits are so situated that they are reached by stimuli coming from every quarter—sometimes augmenting, sometimes interfering with each other. We may not be able to say how they control action, but we may believe that their intermediary position is advantageous in determining what the act shall be.

Among these secondary circuits are innumerable lines of communication (through points of mutual contact), and action is determined by the paths that the stimuli take. If stimuli follow those paths that lead to useful and beneficial action, the animal may live to have the like occur again and again, until a main travelled road for such stimuli is established; then the action may become habitual.

Thus the structure and arrangement of these secondary circuits are such as to furnish a means of controlling and coordinating responses; and these controls may become quite as automatic as the reflex arcs themselves. When conflicting stimuli come in, which one shall have the right of way is determined by the availability of the paths that these secondary circuits furnish.

It has come about in the evolution of the higher animals that the chief control center, the upper brain with its associated sense organs, has been located near the front end of the body. The front end first comes in contact with new features of the environment, and has need of the

best agencies of discovery, especially of these sense organs that are responsive to stimuli coming from a distance: eyes, ears and nose. Such organs can give knowledge of the presence of an enemy before their possessor has fallen into its grasp; they can locate food or shelter or kindred that might otherwise be passed by blindly. It is most fitting therefore, that the part of the central nervous system with which these "distance receptors" are connected should assume the regulatory function.

The brain is primarily an aggregate of neurones, combined in circuits and connected more or less directly with all the lower circuits of the nervous system. The connection with the organs of outlook in the head is most direct, and well worn reaction paths for stimuli coming from these organs have been established. Needful actions are therefore readily brought about; the effects of unimportant stimuli are cancelled and rendered ineffective.

The growth of the control centers in the central nervous system has ever meant a multiplication of the channels of intercommunication between the added neurones in these centers. Conscious control has been attained by the development of accessory circuits that are not directly responsible for the ordinary activities of the body. The primary functions of reflex response not being required of them, they have taken on new functions of control, and have come to preside over the voluntary activities of the body.

The neurones are by no means to be considered mere mechanical contraptions; they are living cells, having their own ways of living, consuming food, and developing

energy. They may go into action whether stimulated from the outside or not, and thus they may give rise to new phenomena of behavior. Their terminals are conjoined in numberless ways, and although they are not reached directly by a single external stimulus, they are indirectly reachable by all. The effect of a given stimulus is no longer an unvarying impulse and action. In the labyrinth of brain paths the stimulus sets off the whole chain of impulses that have followed its like in the past, and the accompanying pleasurable or painful results are recalled in memory along with the urge to action. If these were painful, the new control center has power to direct the action into new channels.

A child, on seeing for the first time a pretty bee upon the window pane, is moved to catch it with his hands. If allowed to do so, he learns something about bees. The impulse to touch the bee and the painful results that immediately follow become so intimately associated in the by-paths of his brain that the next time that he sees a bee (or it may be even a fly) on the window pane, along with the impulse to touch it comes a countervailing impulse arising from the results of former experience. Thus the new control center steps in and prevents the usual actions by initiating new ones.

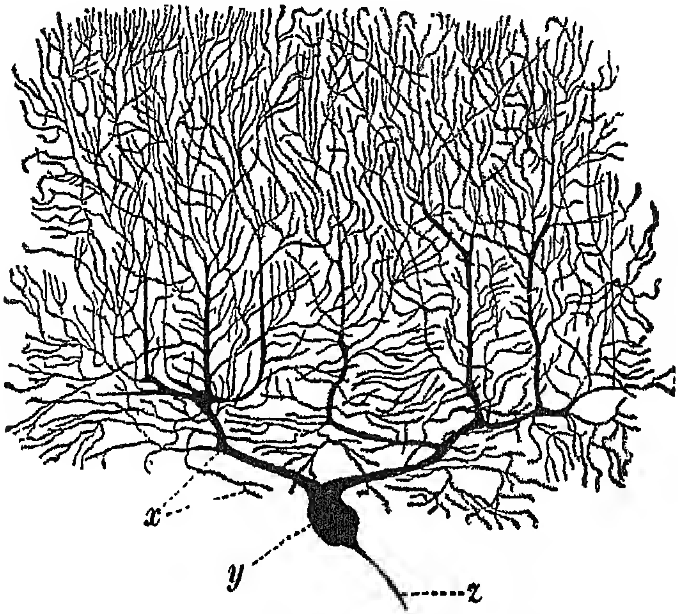
Perhaps we may compare this new control center, the upper brain, to the referee at a game. He is not necessary to the progress of regular play, but he may with advantage step in and control things in case of conflict or appearance of unsolved difficulties.

The cerebrum or upper brain is the chief control

center of the nervous system. It is deeply divided into right and left hemispheres, with very large underlying fiber tracts called cross commissures joining them. The cellular upper layer (cortex) of each hemisphere is marked off by convolutions into principal areas called lobes (frontal, central, parietal, and temporal), and the lobes are incised with lesser wrinkles. Within the hemispheres are millions of association fibers connecting each part of the cortex with other parts. The upper brain is also connected with the underlying parts and with the spinal cord by means of large fiber tracts. The central nervous system has become a vast complex of neurones whose fibers tend to run, in the main, in parallel strands like cables, and whose cell bodies tend to be massed together, forming control centers. Outside the cord the cell bodies form ganglia; within it they compose the gray matter of cord and brain (the grayness being due to their more granular protoplasm). Cells fill the central area in the cord from end to end. In the lower part of the brain they become segregated into cell groups with intervening fiber tracts. In the cerebellum and cerebrum they compose the outer layer of gray matter, the cortex. This wrinkled layer of gray matter on the surface of the cerebrum that "tops us out," so to speak, is the seat of high command. Its cells are the ruling class among the cells of the body.

The structure of the cerebral cortex is of great interest to us because it is the chief organ of the mind. It is composed of many millions of cells. Five layers are recognizable, differing somewhat in form and cell arrangement. All of them are extremely complicated in the branching

of their terminals. A single cell from one of the middle layers of the human cerebellar cortex is shown in the figure. Its many branchlets are interlaced and in contact



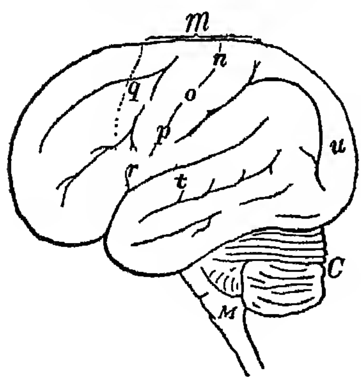
A single brain cell from the human cerebellar cortex. *x*, the dendrites; *y*, the cell body; *z*, the base of the nerve fiber. (After Stohr.)

with those of adjacent cells. If here, as elsewhere in the nervous system, nerve cell tips are gateways for the conveyance of impulses, how manifold are the ways in which these cells may react upon one another! The mere mechanical complexity of our thinking apparatus is beyond the compass of our thought.

Thought, to be sure, is something more than nerve cells tickling each other; but we may still say, here is the loom on which thought is woven. It is difficult to express that which one does not fully understand.

Structurally the cortex of a rabbit's brain is very like that of a man. The cells of the cortex are somewhat fewer and there is less development of branches and of intercellular substance. The mechanism in the two is therefore much more alike than the great difference in mental capacity would lead us to expect. The difference has been compared to that of two watches, one of which is a perfect timepiece while the other will not keep time correctly—largely a matter of better adjustment between parts that are superficially very much alike.

There are no very striking differences in structure of the different parts of the cortex, but that functions are localized in it may easily be determined in the middle motor area; for a stimulus applied at a given point there will produce a response in muscular movement in one particular place. The definiteness of this response has been aptly compared to that of particular tones of a piano that result when certain keys are struck. The surgeon



A diagram of localization of functions in the left cerebral hemisphere. M, the medulla; C, the cerebellum; *m*, the great motor area that occupies the middle of the hemisphere, with a few of the control centers approximately indicated: *n*, center for leg; *o*, for arm; *p*, for face; *q*, for head; *r*, for organs of speech; *t*, center for hearing (brain deafness may result from its injury).

who knows where the fibers run may locate a hemorrhage within the skull by observing what portions of the periphery of the body are paralyzed. It will be on the oppo-

site side of the body, however, for in the medulla the long motor fibers cross over from one side to the other.

In the primate series the upper brain attains its greatest development. Nowhere else can the evidences of its gradual development be better seen. In Tarsius the hemispheres are small and the surface of the cortex is smooth. In the Old World monkeys the hemispheres are larger and their upper surface is moderately convoluted. In the apes these increases continue, gibbon, orang, and chimpanzee, each in order, progressively advancing. Most like the human brain is that of the gorilla, but the difference in size is very striking. The weight of the upper brain or cerebrum of man is about five times that of the gorilla.

It is brain development and that alone that justifies the placing of man at the top in the zoological classification. In every other physical endowment he is surpassed by other animals.

Summarizing our brief story of the development of a responsive mechanism we may now say that we have briefly traced its evolution as evidenced by conditions found in the lower animals, and have glimpsed the increasing capacity for response that accompanies increased complexity of organization. At bottom it is a story of cell life. Nerve cells appeared, more elongated than other cells of the body and better adapted for sensory communication between distant parts. At first they were hardly more than mere connectives. Reaching farther they could communicate farther. The cell outgrowths became

nerve fibers. The cell bodies clustered together for better protection and for closer association; and soon they came *to exercise a regulatory function over the parts to which* their fibers were distributed. They became control centers, into which one set of fibers brought all the impressions from the outside world, and out of which another set of fibers carried the impulses to make response.[2]

Organs of special sense appeared: organs of contact first, organs of touch and taste; then, distance receptors; organs of smell, hearing and sight; and these last conferred immeasurable advantages. These brought numberless impressions of the outside world.

The sense organs supplement each other. Taste, smell and hearing give us hardly any conception of form or of magnitude; nor does touch for large objects, except in successive impressions as parts are successively explored; but the eye may instantly reveal the whole content of environment, in form, in magnitude, and in action. Such are the precious powers conferred by this incomparable organ and so great are its advantages that eyeless animals (save those too small for ordinary vision) are practically absent from the lighted places of the earth.

Ears possess the great advantage of giving notice of presence of enemies in the darkness as well as in the light, when hidden as well as when in the open. Well developed, they confer great powers of discrimination upon their possessor. For social creatures ears have their value

[2] In more strictly scientific terms Sherrington says of the nervous system that it "works through lines of stationary cells along which it dispatches waves of physico-chemical disturbances, and these act as releasing forces in the distant organs where they finally impinge."

greatly advanced by the development of sound-producing organs. Ears and voice together constitute the basic equipment for social intercourse.

With the development of these new receptors, there came a great increase in the size of the control centers. A "Department of Communications," so to speak, was organized to take on some of the increased business of the body. Ganglia grew apace, and in the vertebrates the control centers became organized into a lower and an upper brain.

In the latter there finally came to be established a ruling class among the cells of the body—a class set apart for control. If at first its function was solely that of making automatic responses, in the end it came to have the power to initiate new acts in absence of external stimulation. Acts unsuited to the conditions of environment were eliminated and more profitable ways were substituted and repeated until they became habitual.

While living was so simple that a few recurrent acts met all its needs, a very simple nervous apparatus sufficed; but with increasing severity of competition, improvements in the responsive mechanism conferred great advantages in the struggle for existence.

It is nerve and muscle that distinguish the animal from the plant in the beginning, and it is brain, with its accessories of sense perception and its power of directing muscle, that confers predominance among animals in the end.

Chapter VI

THE DEVELOPMENT OF BEHAVIOR

As animals differ in their nervous equipment, so they also differ in their activities and in their capacity for improving their reactions to environment. Again we may with advantage consider a few typical examples in progressive series by way of illustration.

Attractions and avoidances fall within the range of action of all living protoplasm, and may appear while as yet there is no nervous apparatus developed, as we have seen in the amoeba. Another single-celled animal, *Paramoecium,* is of a higher structural type, and its activities are of greater range and precision. It offers a good example of behavior of perfectly automatic and unvarying kind; so with it we will begin.

This little animal is commonly found in jars of water that are left standing about a biological laboratory. It is just large enough to be seen with difficulty by the unaided eye. It appears as a little white elongated speck, swaying back and forth as it swims through the water. On closer inspection it is seen to be swimming in a spiral and to have definite form.

Viewed under the microscope, paramoecium has some-

what the outline of a slipper. It travels with the heel end of the slipper foremost. Its body is covered all over with delicate hairlike tapering processes called *cilia,*[1] that lash backward in unison, and propel the body through the water. There is a mouth groove along one side ending in a food pit or a sort of gullet, and along the edges of this groove there are longer and stronger cilia that drive food particles down into it. The groove is oblique and guides the body in a rolling motion and in a spiral, keeping the mouth on the side turned toward the axis of the spiral. The outer surface of the body has become thickened, giving permanence of form and a measure of support for the cilia. There is a suggestion of a nervous mechanism in the underlying protoplasm, where there are certain delicate strands of tissue having special sensitiveness and contractility.

Paramoecium has one well marked avoidance reaction, and only one. Meeting with an obstruction in its course, it reverses its engine, so to speak, swims backward a little

Behavior in Paramoecium: *a,* the avoidance reaction; 1 to 6, successive positions; arrows indicate direction of movement (after Jennings). *b,* the contact reaction.

way, swings to the side away from the mouth and then starts swimming forward again. If the obstruction is not

[1] Cilia (Latin), eyelashes.

cleared by the first swing-out, it repeats the process until the path forward is unobstructed.

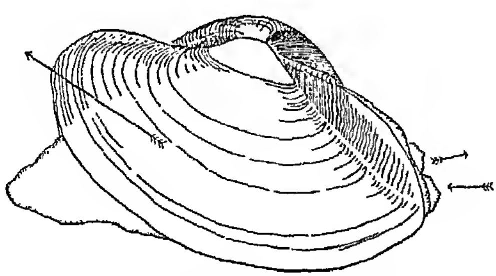
But if prodded from the rear with a sharp point, it reacts as before; instead of swimming away from the trouble it reverses and dashes against the point, before swinging aside and starting forward again. Moreover, whatever the stimulus, be it electrical, chemical or mechanical, it reacts in the same way, stopping, reversing, swinging aside, and starting again. It is a perfect automaton.

Attraction is less easily observed in paramoecium. When in swimming about it chances to come in gentle contact with soft flocculent material such as a suspension of bacterial jelly (bacteria are its normal food) it will come to rest with its oral cilia in contact with the stuff. Thus it may remain quiet for a considerable time, as if at a satisfactory anchorage. When thus resting and feeding it is less sensitive to stimulation than at other times.

Its food-taking appears to be entirely automatic. It is quite undiscriminating as to what it eats. Along with bacteria it will swallow anything else that is small enough to go into its mouth. Feeding paramoecia on indigestible powdered carmine is an old laboratory trick that every biological student has tried. It always works. It takes only a few minutes to place a few paramoecia in a drop of water on a slide, to add finely powdered carmine to the water, and to see the indigestible carmine particles lashed in by the oral cilia, gathered in a round lump inside the body, circulated entirely around, and then dumped out again unchanged.

Paramoecium shows marked advance over amoeba in speed and precision of locomotion, and in promptness and range of response to stimulation. But it has only these two modes of reaction and never improves or greatly alters them.

When we turn from the protozoans (one-celled animals) to the metazoans (many-celled animals), we find at the foot of the metazoan scale some animals whose activities are almost as simple and quite as automatic as those of paramoecium, and whose stock-in-trade of reactions is almost as limited. For example, there is the fresh-water clam that is commonly found burrowing in the muddy bed of all inland streams and lakes. As everyone knows, it has no head, but it has front and rear ends. At the front, embedded in the tissues above the mouth, it has a pair of "cerebral ganglia" that function as a brain. It has no eyes; it needs none. It lives nearly buried in the



A fresh-water clam with foot partly extended in front, and siphons in the rear. Large arrow indicates direction of travel; small arrows, that of water current, in and out.

mud, and its food is all about, microscopic stuff, free-floating in the water. Its heavy bivalved shell is a complete coat of armor into which the body may be wholly

and instantly withdrawn on the slightest disturbance. In whatever way the clam is stimulated, it shuts up tightly, and keeps its shell closed until danger is past. Then slowly it opens up again, pushes its foot down into the mud below and its siphons[2] out into the water in the rear, and resumes its eternal feeding.

The clam leads a sheltered stay-at-home existence. Its acts are few in kinds and simple in performance, and a minimum of coordinating apparatus (three pairs of ganglia in all, together with connecting commissures and outreaching fibers) serves for their control.

Let us now consider a few examples in which some capacity is shown for varying automatic activity with experience.

A garden spider sits on her orb-web in the sun. If a tuning fork is struck close beside her she will instantly fall to the ground. That is the way she escapes from an enemy: it is her normal avoidance reaction. But she will not drop from her web (and so put herself to the trouble of laboriously climbing up again) after this has been repeated half a dozen times in succession.

Moreover after daily repetition of this experience she may cease to be disturbed at all by the tuning fork. This discloses some power of distinguishing between stimuli; for otherwise no animal could afford to suspend the reaction by which it escapes its enemies.

The caterpillar of the milkweed butterfly when feeding on the edge of a leaf will take a number of bites from

[2] These siphons are the openings of waterways through which circulate the currents that bring in food and oxygen, and carry away wastes.

the edge of a sheet of lead foil if that be carefully shoved alongside the leaf within the range of its jaws. The number of bites taken will diminish with each successive repetition until shortly the caterpillar will stop biting as soon as its jaws touch the foil. But if today we train a caterpillar not to bite lead foil, tomorrow it will show no sign of the training: it will have to learn avoidance all over again, with the same slow subsidence of automatic reaction.

The caterpillar has a bit of a brain; at least it has in its head a consolidated pair of cerebral ganglia that are larger than the other ganglia of the body and more directly connected with organs of special sense. This brain is adequate to control the performance of a considerable variety of activities that are always performed in the same way; it is also capable of feebly altering response to meet changing circumstances, as is shown by the above experiment.

A moth that kills itself by repeatedly flying into the candle flame seems to be wholly lacking in power to change its behavior. It is stimulated irresistibly by the light. Its ancestors for ages have flown to white objects (flowers) at night. In a proper environment there is nothing better than this for a moth to do. Thus it gets its living in the form of the nectar of the flowers. But candles, being introduced into its environment, it flies to a candle, not being able to distinguish between candlelight and the light reflected from a flower; or at least, not being able to respond differently, or even to withhold response. Hence, although it may merely be singed at the first contact with the flame, it repeats the act as long as it is able to respond at all.

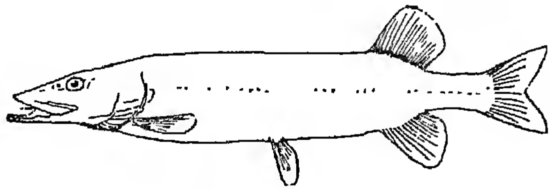
Thus it falls before a peril that is new to its racial experience and that is not provided for in its nervous organization. Brain action is not necessarily less automatic than the action of a reflex arc. The moth has a brain but it does not seem to learn by experience. If past experience is reproduced at all in memory, the impulses arising from it are powerless to check those that arise from the next perception of light. Control here is based on racial, not on individual experience.

A new-hatched chick runs around pecking at all sorts of things with its beak: at things suitable for food, and at things wholly unsuitable. After a time it seems to discover that the things good for food look different from other things, and its pecking becomes selective. A bit of discernment comes in to direct the act that is purely automatic in its performance.

Another example. A young pike when first hatched from the egg goes swimming about carrying a large mass of unabsorbed yolk. When this store of food has been used up, the little fish begins opening its jaw wide and snapping them shut, after the manner in which pike and other carnivorous fishes capture their prey. For a time this "strike" (to use the angler's term for it) is not directed at anything in particular; it is purely automatic, occurring about once a second with almost the regularity of the ticking of a clock.

In the weedy shoals where young pike are hatched, the water teems with microscopic life, suitable for their food. There are water fleas swimming about. They swim in a manner equally automatic, and are generally distributed

through the water. So it will come about that once in a while a random strike of the little fish's jaws will capture



A pike.

a water flea. Soon the little pike will use its eyes, and having tasted food, will direct the snap of its jaws toward particular water fleas. The action of striking will continue to be automatic through life, even through the life of the great fish.

The doings of a clam consist of a few simple acts that are endlessly repeated, and for these doings three pairs of ganglia, so small that one has to search carefully to find them among the tissues, three little clusters of nerve cells, are enough. The activities of one of the higher vertebrates on the other hand are endlessly varied. A squirrel, for example, must hunt for scattered food. It must run from its enemies; it must climb and cling and leap with precision; and it must vary each of these acts to meet ever-changing conditions. The squirrel has a big brain suited to these ends.

"Eternal vigilance is the price of safety."

It is not possible for us to trace step by step a series of improvements in action corresponding to better brain developments; but the examples already cited show at least that animal be-

havior begins with purely automatic and unvarying acts that are few in kind and endlessly repeated, and ends in the possession of a considerable degree of superadded volitional control. However simple or complex the behavior, it suffices for the activities that keep life going and keep it adjusted to the conditions of the environment in which it was developed.

All brain power rests on a basis of organized reflexes. Superadded to reflex activities, three higher types of nervous action appear to have been successively attained, and they are reacquired by the individual in his own time and in something of a necessary sequence:

1. The power to retain and recall the effects of past experience, in a word, *memory:* power to recall automatically and instantly, not only the action that followed upon a particular stimulus, but also the resulting consequences of that act.

2. The power to discriminate between stimuli as to their relative importance, and to forestall response to those that might lead to improper action.

3. The power to initiate new modes of action in absence of external stimulation, and thus gain new experience. This last is the key of entrance to the realm of intellectual supremacy.

Broadly speaking, animal behavior is thus seen to begin with blind, uncomprehending reaction to external stimulation, with automatic performance of wholly predetermined acts. This we study in the name of Physiology.

Built upon this automatic activity, and thereby arising to a higher level, are the more complicated acts commonly known as Instinct.[3] These may be equally automatic in performance, but they are consciously performed. These will be the subject of our next chapter.

Superadded to instinctive acts, and in some measure controlling and guiding them, are the activities that the individual may learn in his own time as the results of personal experience. To these we will devote another chapter under the heading of Learning.

[3] More technically known as "chain reflexes."

Chapter VII

INSTINCT

Instinct is inherited behavior. It is that part of behavior with respect to which animals are born fully educated. It is automatic and instantaneous in action. It is common to all members of a species; in matters of vital importance all tend to act alike.

It is by instinct that birds build their nests, and that spiders spin their webs, and that ant-lions dig their pits. They do these things without practice, without fumbling; they do them without instruction or example. The products of these amazing activities are like the work of skilled artisans: they are often of surpassing elegance and beauty.

Instinct is as automatic as breathing. Like breathing its component elements are within the range of consciousness, but they are for the most part unconsciously performed. In a quaint old volume on "Natural Theology," William Paley defined instinct as "a propensity prior to experience and independent of instruction." This definition at least sets an upper limit, distinguishing between instinct and intelligence. No one has been able to set a lower limit. Pavlov called instinct a complex of reflexes.

Whether or not we can delimit the boundaries of in-

stinct, we can at least set down some of its characteristics, as follows:

1. Instinct is innate and ready for instant action whenever the necessary conditions for it arise. A kitten does not need to be taught that a dog is its natural enemy; it is born with the knowledge. At sight of a dog, or it may be even the faint smell of one borne on a passing breeze, the kitten arches its back, fluffs out the hair on its stiffened tail, unsheathes its claws, and spits. The snakeling on hatching emerges from the egg shell with its forked tongue darting and its whole posture threatening. The scent of a rabbit if wafted to the nostrils of a sleeping hound will awaken him out of sound slumber when loud noises, such as the rumblings of trucks near at hand, will not disturb him at all. Instinct has been evolved with the animal and is ever ready for action.

2. Instinct is fit, that is, adapted to natural conditions and suited to the environment in which it was developed. Instinctive behavior has all the aspects of superior wisdom. By instinct the aerial adult dragonfly drops her eggs into the water where she herself cannot live, in order that her aquatic young, which she will never see, may find there a suitable home. The nectar-sipping butterfly that finds her food in flowers of many kinds seeks one particular kind of plant on which to lay her eggs; yet the plant is one that has furnished her no food. She makes no mistake, as we might, of botanical determination. The future of her species demands that she make no mistake at this critical point; her offspring will require that one kind of food.

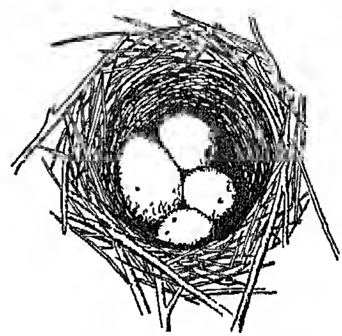
A wonderful example of instinctive behavior is seen in the relations between the horse and the bot fly. The young (larvae) of this little fly live in the stomach of the horse and are very injurious, weakening, and sometimes causing the death of the animal; but the adult fly, hardly larger than a housefly, is quite incapable of inflicting pain. It does not bite or sting. It merely buzzes around the forelegs of the horse, seeking to attach its eggs to the tip of the hairs on them. A little tickling sensation is the utmost approach to pain that it can give the horse.

Yet the great beast is terrified by its approach, and if free in the pasture, dashes for the nearest thicket and through the low herbage, thus brushing the fly aside; if in the harness, it will try to run away, and will be very hard to manage, as the farm boy may well know from trying experience. The horse behaves as if he knew of the harm that would come to him later, should he bite the hairs off his legs and swallow the eggs and should they hatch in his stomach into bots, and feed there as parasites. But he certainly knows nothing of the kind; he probably never sees the eggs on the hairs at his knees; he certainly knows nothing of the bots in his stomach, and nothing of the fly except its peculiar buzzing. To this he responds automatically with the behavior that has saved his ancestors from death by bots in the past, and that has been repeated by successive generations until it has become fixed in the habits of the species.

3. Instinct is blind; that is, it is inadaptable. Though perfectly suited to normal conditions it may become

utterly stupid and ineffective when those conditions are changed. The brooding instinct of the hen is a perfect example of this. When she has laid her eggs she retires from barnyard society and, giving up her freedom, she sits on them for three weeks, keeping them warm with the heat of her own body. Thus she incubates them; but she will sit just as faithfully on a nest of china eggs, if these be substituted for her own.

The behavior of the sparrow toward the cowbird's egg is even more remarkable and significant. The cowbird finds a nest of sparrow eggs, throws out one or more of them and substitutes one of her own, but does not return to the nest. The sparrow then stupidly incubates the cowbird's egg along with her own. After hatching, she feeds the interloper along with her own offspring. It is stated on good authority that sometimes, after the strapping cowbird infant has crowded her own offspring out of the nest, she will go on feeding it until it is well grown, all this notwithstanding that the cowbird egg is quite different in appearance from her own, and the young bird still more different. The mother instinct is easily imposed upon.



The egg of a cowbird in the nest of a song sparrow (drawn from a photograph).

A terrestrial "trap-door" spider that lives in a burrow in the ground, closes the mouth of its burrow with a circular lid. This lid is fastened by means of a hinge of spun

silk to one point on the burrow's rim, and opens and closes like the lid of a coffeepot. When threatened with danger the spider retreats into its burrow and pulls down the lid. The spider attaches to the upper surface of the lid such trash and small vegetation as covers the ground round about. Its burrow is thus rendered inconspicuous. This perfect concealment tells no tales of the spider's whereabouts.

This looks like planning and forethought on the part of the spider; but a little change in the environment will reveal great stupidity. If both the lid and a surrounding area be cleared of the trashy covering, the spider will gather more trash and replace it on the lid—*but only on the lid*, thus revealing, not concealing, the location of the burrow.

Fatal want of discrimination is sometimes shown toward objects of the natural environment. Thus the flesh-fly whose young are carrion-feeding maggots may be stimulated by the odor of the carrion-flower to lay her eggs upon its blossoms. There her young, on hatching, will perish for lack of food. The fly does not possess such perceptive faculties as will enable her to distinguish between a flower and a dead carcass. The fly probably knows neither carcass nor flower, but only a certain kind of olfactory stimulus that may come from either, and to it she responds automatically.

4. Instinct runs in necessary sequences, the successive acts being in a fixed and unalterable series. The method of a bird in building her nest is as definite as though she 'lowing a blueprint plan: first the foundation;

then the walls; lastly the lining and decorations, with certain classes of materials having specified qualities of length and strength, of rigidity or pliancy, of plasticity or porosity, of smoothness or softness selected for each; with breadth of base, thickness of walls, height and depth and curvature within and decorations without, all predetermined. The fixity of instinct is shown by the fact that species may be recognized by the nests they build and that satisfactory keys for specific identification are based on nests alone.

A little moth that was studied by the author in China has a caterpillar that lives as a miner within the leaflets of the gumpod tree.[1] The silk spinning of this caterpillar is in two successive and inseparable operations. When the full-fed caterpillar emerges from its hole in the leaf it first spins on the under side a mattress of silk that is stretched across a hollow area. This mattress at its edges is made of close-laid parallel threads of silk with diagonal interlaced threads forming a thinner sheet of tissue between. The contraction of the threads on drying bulges the leaf upward, widening the cavity above the mattress. Within this space the caterpillar next spins about itself a close-fitting white silken cocoon in which to undergo its transformation.

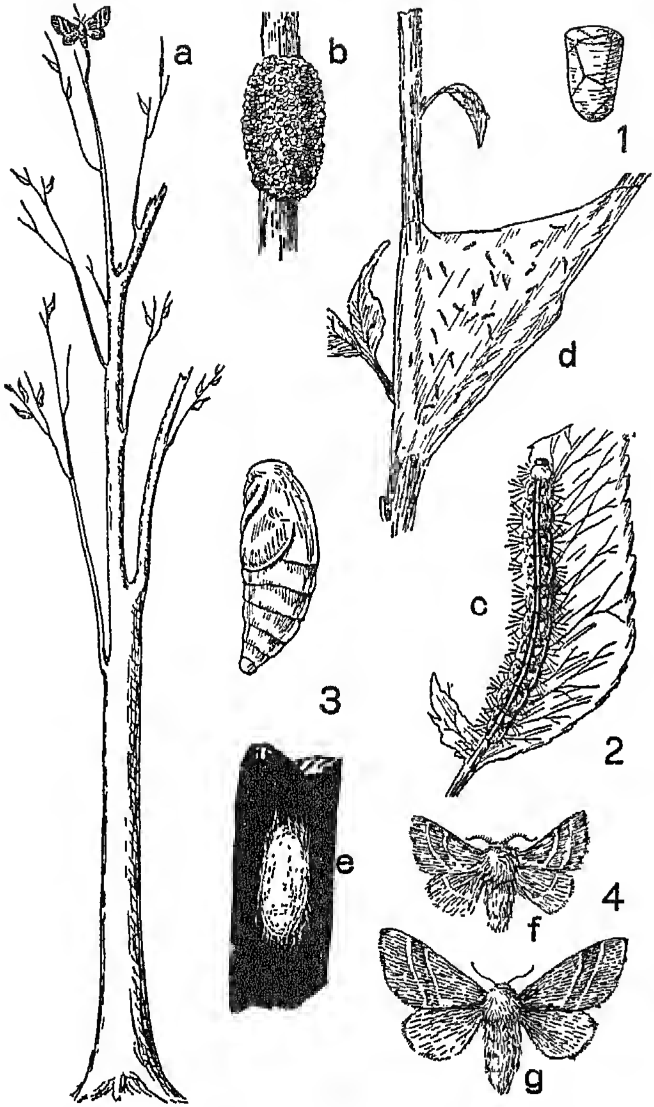
If a caterpillar that has just emerged and is ready for spinning be placed on a mattress that has been completed by another caterpillar, it will not take advantage of the work already done and proceed to complete it (thus saving its own energy). It will not utilize the products of

[1] The moth, *Leucoptera substrigata;* the tree, *Sophora japonica.*

another. It must start at the beginning, and make its own mattress, as well as its own cocoon. There is no other way but to follow the established order, with each step conditioning the one next to follow. There is a necessary sequence.

5. Instincts develop along with the body, and behavior changes as the body grows. This is most strikingly shown by those animals that have the greatest changes in bodily form during their lives. Let us illustrate it with the common tent caterpillar—that public nuisance that weaves its unsightly webs in the branches of wild cherry trees along every roadside in the northeastern United States. In its life cycle are the four stages common to insects having "complete metamorphosis": egg, larva (caterpillar), pupa (chrysalis), and adult insect (moth).

The caterpillars hatch in the spring from eggs that were laid during the preceding summer in cylindric clusters encircling the tips of cherry twigs. They crawl out on the fresh leaves of the twig and feed there in companies. Each little caterpillar spins a thread of silk as it goes—lays it down underfoot and leaves it there. All the caterpillars creep downward into the fork of the twig between their times of feeding, and their silken threads become crisscrossed in the fork and pile on one another. Thus the "tent" is built up in the fork, and it may get to be several inches deep, and become a resting place for a great mass of caterpillars before their growth is completed; for they all go out to feed and return to rest, spinning as they go.



LIFE HISTORY OF THE TENT CATERPILLAR

1. Egg from clusters at *a* and *b;* laid in July, hatch in April.
2. Larva, on leaf at *c*, with others in tent at *d;* active by day; feeds on leaves through May.
3. Pupa, removed from the cocoon shown at *e;* inactive until transformation.
4. Adult moths: male at *f*, female at *g;* active at night.

When they are grown their behavior changes. They leave the tent singly and creep down the trunk of the tree to the ground and crawl under any available shelter, seeking a place of seclusion and darkness in which to undergo their transformation into moths. They now shun their former companions, refuse to eat, and avoid the light. Each creeps into some darkened crevice alone, and spins about itself a loosely woven silk cocoon. Now there is secreted in addition to the fluid silk a creamy white chalky substance that fills the meshes of the cocoon.

Within the cocoon the caterpillar changes to a pupa by slipping off its old skin and thus releasing the rudiments of wings, legs, antennae, and other parts of the moth that is to be. This is a time of making over the caterpillar into the moth. The pupa remains quiet in its cocoon for about two weeks while the remodeling, both external and internal, is in progress.

Then the moth comes forth, with another entire change of habits. It no longer spins—the silk glands were exhausted in cocoon making, and their remains were discarded in the making over. It now has wings and can fly about. It also has long legs and antennae, whereas those of the caterpillar were very short. Its body is no longer hairy but is covered all over with fine scales, microscopic in size and dust-like in appearance when shed (whence the name "miller" or "dusty miller" commonly applied to moths). These scales are arranged in a neat pattern of reddish brown and grey that matches the bark of the tree trunks on which the moth rests by day. By this resemblance they escape the notice of many of their

diurnal enemies. They sit tight until nightfall, when they go abroad. They no longer eat cherry leaves; they eat nothing. Their jaws have degenerated.

But what is vastly more important from the standpoint of behavior, they now have reproductive organs, with sex cells well developed. These existed as mere rudiments in the larvae; they matured rapidly during the quiet pupal stage and are ready for use. Active animals that cannot eat cannot live long. The one item of unfinished business on the program of the moth is provision for the next generation.

By night the moths seek their mates, and after mating the females seek the wild cherry trees. They deposit their eggs in clusters on the outermost twigs, preferably of healthy young trees, never mistaking a dead twig for a living one. No moth ever mistakenly used a twig of elm or birch, mistaking it for cherry, as we might do. She stands the eggs on end in a neat cylindric girdle around the twig, several hundred of them; and then covers the mass with a layer of sticky waterproof secretion, tapered down to the twig at the ends, which soon hardens into a glistening coat that will protect them during a period of some nine months' incubation. Then her work is ended.

The eggs will hatch in the spring when the rising temperature reaches a certain daily average. External warmth furnishes a stimulus that incites the caterpillars to burst the egg shells and come forth. But the best temperature for hatching will have occurred repeatedly during the long period of incubation without that effect. Hatching cannot occur until the body of the caterpillar

has reached the proper stage of development, nor can feeding, or spinning, or cocoon making, or mating, or egg-laying. Behavior changes as the body changes, and is attuned to the needs of each stage of development.

If we set down in parallel columns, and in their proper sequence, on one side the major activities in the life of the tent caterpillar and on the other the corresponding phases in bodily development we shall be able to see clearly how they proceed together.

Major activities of the species	*Internal states conditioning them*
1. Hatching of the egg.	Completion of the nutritive equipment with the exhaustion of the yolk in the egg.
2. Food seeking.	Hunger.
3. Silk spinning.	Silk gland growth.
4. Cocoon making.	Surcharging of the "chalk" glands.
5. Formation of the pupa.	Development of adult organs under the larval skin.
6. Emergence of the adult.	Perfecting of the adult muscular system.
7. Mate seeking.	Ripening of the sex cells.
8. Egg-laying.	Fertilization of the egg.
9. Egg covering.	Charging of glands with covering material.

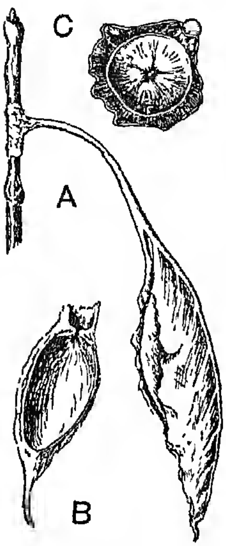
A bird builds her nest when the condition of body and brain compels. No stimulus has any effect what-

ever until body and brain are ready. Maturity must be reached and eggs must grow, and mating must take place; and when all is ready the simplest sort of stimulus, the sight of suitable materials (straw or fiber or hair, not notably different from a thousand other things that the eye might fall upon), serves to set the complex activities of nest-building going. The stimulus is but the spark that sets off the power in the mine. In itself it may be insignificant, but its effect on the bird is all important; for it determines the very conditions of existence. Nest-building must wait on the finding of suitable materials: materials not too different from those the sight of which has called forth nest-building activities in the past, and all the subsequent acts of rearing young wait on nest-building. This means that the want at any point of the stimulus that can set off an appropriate action blocks the remaining acts of the series and leads to failure.

An oriole building-project.

6. Many instinctive acts are performed but once in a lifetime. They cannot therefore have been perfected by practice, yet some of them are marvelous. The cocoon-making of the Promethea moth will illustrate this. Its caterpillar is one of the commonest of our large American silkworms. It feeds on the leaves of our deciduous

forest and shade trees. *When grown it spins a silken cocoon in which to pass the winter.* It attaches the cocoon lengthwise to the under side of a leaf and draws the edges of the leaf close around it so as to conceal it. It also attaches the leaf to the tree as if to prevent its falling to the ground where it might be destroyed. The attachment is made by means of a strong band of silk broadly applied to the woody twig at the leaf base. Here again is the deceptive semblance of foresight and planning.



The cocoon of a Promethea moth: *A*, in a folded leaf, securely attached to a twig; *B*, section of same, showing the pupal chamber; *C*, the valve-like exit hole, viewed from within.

The cocoons hang all winter, always on deciduous trees, where they may be looked for after the time of leaf-fall. Within the sheltering leaf the caterpillar has spun its heavy-walled cocoon of silk: first an outer coat that is firm and tough, a protection against cold and moisture and predators, and inside this, a soft lining of loose silken threads. At the upper end of the cocoon an opening is left for emergence of the moth in the spring. But it is barred against intruders by a most interesting, ingenious, and effective valve-like arrangement of the loose silk in ridges that converge to the exit. Filling the opening as they do, these stand as a barrier to entrance from the outside, but they will guide the moth to the only place where she can push her way out. The caterpillar spins a cocoon but once.

7. Instinctive behavior carries its own evidence of

evolution. Habits, like organs and like organisms, may be arranged in series, graded from simple to complex, with intermediate conditions connecting the extremes.

The case-building habits of the caddisworms, may be taken to illustrate this. Caddisworms are caterpillar-like aquatic larvae that live in all fresh waters. They construct tubular cases in which to dwell—portable cases, made of sticks and sand grains fastened together and lined with silk. Any one may see these on looking closely into the bed of a clear brook. At first he will see what appear to be cylindric clusters of dead sticks and pebbles moving jerkily about over the bottom; then on looking closer he will see a head and legs reaching forward from the front end of a cylinder, instantly disappearing within it on the slightest disturbance. Hooked claws on the feet take hold of the stream bed, and drag-hooks on the tail end of the worm clutch the silken lining of the case and drag it along. Thus the caddisworm always carries its house on its back. It travels by thrusting the legs out at the front door and pulling the case along.

A caddisworm in its case made of sticks.

The case itself is most ingeniously constructed. Whatever the materials (and these vary with the species and with the stuffs available) they are fashioned into a neat cylindric tube a little longer than the body of the worm. There is great variety in the decorations of the exterior but the inner wall is always smoothly lined with silk. The caddisworm has silk glands somewhat like

those of the silk worm. These glands produce a fluid silk that is spun out of the mouth as a thread. It is soft and adhesive at first, but quickly hardens on contact with the water. This silk is the "binder" used in putting the case together. As the larva grows it adds bits at the front, and tears down at the rear, keeping its dwelling to proper size and form. By making additions and enlargements and repairs as needed the house is kept habitable and serviceable throughout its growing up; and when feeding is ended and growth fully attained, then a strong anchorage and a few new fittings for sanitation and security make of it an excellent transformation chamber. The worm fastens its case down to a stone or other solid support and closes both front and rear opening with gratings or bars that permit fresh water to enter but keep out enemies. Within this snug retreat it transforms to a pupa,[2] and after another change of form it emerges from the case and from the water as the winged aerial adult caddisfly.

The very novelty of this manner of life leads to curiosity as to how it started. Hints as to its origin may be had by comparing the habits of different members of the group,[3] as follows:

A. A primitive green caddisworm, *Rhyacophila,* that spends nearly the whole of its larval life as a thick-skinned naked larva living among the stones in the riffles of streams, makes no case at all; but when ready for trans-

[2] In its life history the caddisfly has the same four stages of changes of form as has the moth previously discussed (p. 88): egg, larva (the worm), pupa, and adult.

[3] This is the explanation offered by Dr. Cornelius Betten, who knows the group intimately.

formation it builds about itself an encircling barrier of pebbles in a crevice between two large stones, and within this barrier it spins a bare silken cocoon. The cocoon is tight-fitting, and closed at both ends. The gathering of pebbles to construct a fixed pupal shelter may have been the first step toward the making of a portable case. Many larvae other than those of caddisflies construct pupation shelters.

B. Another caddisworm, *Chimarrha,* is of somewhat similar habits, but it makes a closer fitting pupal shelter that is joined by some threads of silk to the cocoon inside. Again the case is fixed in position and not portable.

C. Another caddisworm, *Mystrophora,* begins case-making earlier in life, while the well grown larva still has need to travel about in foraging; and the case is carried about on its back as a defensive armor. The case is intermediate in form between the dome-shaped cases of the two above-mentioned larvae and the cylindric cases of the higher caddisworms. It is shaped more like the shell of a turtle, long above and short underneath where a cross-bar of agglutinated sand grains occupies the place of a turtle's plastron. When the caddisworm is ready for transformation it removes this cross-bar and fastens the edges of the "carapace" solidly down to the stone. It lines the walls and covers the stone floor of this snug domicile with spun silk. The significant thing here is that the well-grown worm travels about for a time in a portable case. And this leads up to the perfected habit as first described.

D. Any one of a host of caddisworms might be selected to represent this final step in the perfecting of the case-making habit; for that habit belongs to most members

of the group. It probably accounts for the success of the group in the struggle for existence. The caddisworms named under A, B and C are exceptional in their habits, having retained some relics of primitive ways.

This story of the evolution of the cases is corroborated by evidence from the anatomical structure of the worms themselves: the more primitive worms make the less perfect cases.

As there is abundant evidence of loss of parts in the evolution of animals (the tail, for example, in *Homo sapiens*), so also certain items of behavior may be lost. The queen bee in the hive offers an example. She comes of a line of bee ancestors that are remarkable for their industry, but she works not at all. In the economy of the hive there has come about a division of labor, relieving her of that duty. Among more primitive bees the females work. They lay eggs and feed the young and build the shelter. But in a colony of honey bees the queen is the only fully developed female. She is the mother of the entire colony that may number many thousands. Her share in the economy of the hive is the all-essential one of laying eggs so that the colony may continue. All the common laborers of the colony are worker bees that build the wax cells, gather the food, and serve as nurses for eggs and young. They are undeveloped females that by a strange change of habit in past generations came to be reared in the smaller cells of the honeycomb, and were fed on food different from that which nourishes the queen. In the differentiation of two kinds of females in the colony, the queen has lost her urge to work, and workers have lost their mating instincts.

In the above characterization of instinct the illustrations have all been drawn from animal behavior. This has been done for the sake of objective simplicity and clearness. The instinctive behavior of mankind shows the same characteristics: it is inborn; fit to life's needs; blind and sometimes stupidly inadaptable; runs in necessary sequences; develops with the body; may or may not be called forth but once in a lifetime; and is of ancient origin, slow growth and ineradicable fixity. Let us further illustrate it here by noting, for example, in man only the changes of instinct that follow upon bodily changes, postponing consideration of the role that instinct plays in social evolution to a subsequent chapter.

Man is born with but two pairs of instincts fully developed and ready for action.

Attractions

Readiness to nurse

Readiness to cling with the hands

Avoidances

Fear of falling

Fear of very loud noises

The act of nursing is performed automatically and at first blindly. The infant's lips will close around any soft object that they can encompass, and vigorous sucking will be done on objects affording no food. Parental guidance is needed far more for the human infant than for the young of animals.

The infant's hand will close about a proffered finger, or will firmly grasp any other object placed within its clasp. Very young infants may sustain their own weight by the grasp of both hands about a cane held horizontally

above them. This has often been pointed out as a capacity inherited from a tree-dwelling ancestry.

The two avoidance reactions are both shown by the usual signs of fear: contracting of muscles, catching of the breath and trembling. These acts may be called forth instantly by taking away support from beneath the infant, so that it suddenly begins to fall. They may also be caused by making a very loud clangor near it.

Other instincts appear later, as the body develops. The fear of snakes is absent in infants. It is generally well developed at the age at which children run about alone, the age at which, under primeval conditions of living, they might be exposed to this new peril.

A whole troupe of new urges accompanies the advent of sexual maturity at puberty. When a boy's voice changes his manner with girls changes, and his estimate of the value of girl companionship changes also. Mutual attraction shows itself differently in the two sexes as the two become increasingly differentiated.

In adolescence the sex urge rises; in old age it declines. Along with its rise and decline there is a shift of mental attitudes that seems to be common to all mankind. In each generation youth tugs at the leash of tradition; seeks novelty, excitement, and new experiences; shocks its elders by its reckless behavior. Then, after testing the strength of the lines of the social order, it puts on the vestments of maturity, and in its turn takes alarm at what youth again ventures.

Thus from infancy to old age we continue to act automatically in the way that our ancestors have acted.

Chapter VIII

LEARNING

Many of the lower animals are born educated almost to the full extent of their capacity, the possible lines of action of their whole lives being provided for or predetermined in their organization. The acts most fundamental to the preservation of races, feeding and reproduction, are thus cared for in the main in all animals and in ourselves. So also are avoidance reactions that protect from deadly perils. A chicken flees at the first cry of a hawk although it may be quite unresponsive to the (to us) similar cry of a catbird. Nature has developed this nice discrimination by the elimination of those individuals that do not act properly and with effective promptness. Racial experience has thus been incorporated into the organism in such manner that vitally important stimuli dominate all the activities of the body and enable it to meet the chief exigencies of life.

There is, however, especially in the higher animals, a field of activity in which the reactions are less fixed, and here lies the opportunity for learning by individual experience. This is so large a part of our own life that we have difficulty in realizing how limited it is in many of the lower animals.

In the behavior that is acquired by the individual in his own time there are three principal modes of learning, and they appear in a necessary developmental sequence:

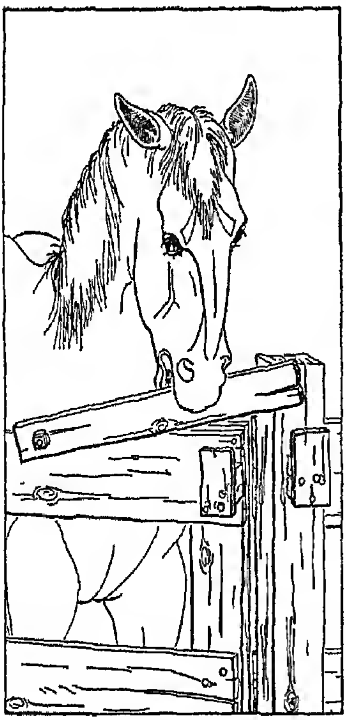
Learning by trial and error.

Learning by imitation.

Learning by experiment.

LEARNING BY TRIAL AND ERROR

The sight of food that is not within reach may stimulate to activities that are predetermined only for the act of feeding, not at all for the method of getting the food.



A horse confined in a bare lot is stimulated to a great variety of activities by the sight of green grass on the other side of the fence. He does many things that yield no satisfactory results; he pushes, he whinnies, he stamps, he rears, he tugs at the toprail with his teeth, etc. Sooner or later by chance he lifts the gate latch with his teeth, and this act is accompanied by a pleasing result: the gate swings open. Another time he is likely to concentrate his efforts at the gate, and to lift the latch sooner, and with fewer ineffective efforts. Every repetition of the success-

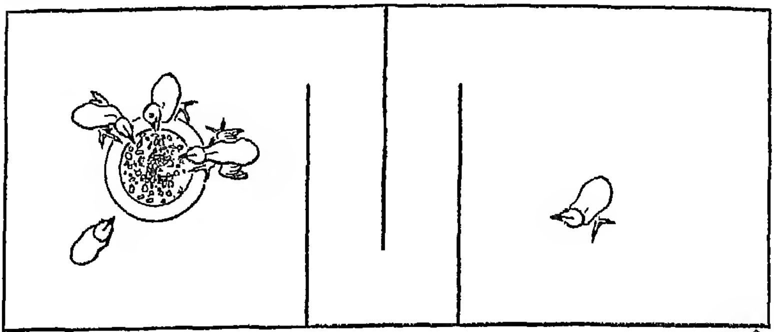
ful act makes its subsequent performance easier. Soon he is able to eliminate all the unprofitable acts and to lift the latch at once. He has learned by trial and error.

Such learning depends upon the possession of a nervous system that is capable of retaining the impressions accompanying an act until the stimulus that called it forth is repeated. Such a mechanism is the upper brain in Vertebrates. It has the power of retaining or reviving alongside every important stimulus the impressions that have come with former responses to the same kind of stimulus, action then being determined by the measure of success attained before.

A favorite method of studying trial and error in animals has been that of placing them in a labyrinth and observing how they learn their way through it to food, or to companions or to other desired goals.

Thorndike's classical experiment, with a few young chicks and a wooden cracker box, is so simple that any one can manage it, and it is very good for showing clearly the details of learning by this process. The box is provided midway with three partial partitions, as shown in our accompanying figure. Thus there are formed two end compartments, each out of sight from the other but connected by a narrow tortuous passage that turns around three corners. Some hungry chicks between one and two weeks old are needed. One is placed alone in an end compartment, and several are placed in the opposite end and provided with a dish of food. The lone chick can hear the others in pleasant conversation at their feeding but cannot see them. It is his lesson to learn how to get to

them. His hunger and his liking for company may be depended upon to move him to make the effort.



His first efforts will be obviously aimless: trying to fly out and falling back; peering through crevices and around the corner; walking back and forth in all directions; standing; peeping; pecking at the walls and at the floor; etc. These will occupy so long a time that the observer who is watching and waiting will marvel at his stupidity. He will walk down the lane a little way and return again and again. He may even turn two of the three corners and return to try more walking and peeping; but when he goes far enough to see the other chicks he will run to them at once.

If at once returned to his own end of the box, it will be seen that he has *not* yet learned his lesson, for he will repeat most of the useless efforts of the first trial, even entering the lane and returning for more wasted efforts. He will probably first quit trying to fly out, perhaps because it is tiresome as well as useless, and will keep more to the side of his compartment from which the lane starts. His second trip through will generally be made more

quickly than the first (the first may take an hour or more) and succeeding ones more quickly still, although there may be much irregularity, and there will be differences in timing with different chicks. With chicks of the age specified, half a dozen trips through the lane generally are enough for learning the lesson. When it is learned the chick will run right through the lane to the other end without hesitation or fumbling.

With older chicks a more complicated passageway must be provided; else they will learn to run through it so *quickly that the details of the learning process will not* stand out clearly. For animals with a higher intelligence much more complicated labyrinths may be used; labyrinths that offer a choice of routes from start to destination. With these it is easy to demonstrate that the route first stumbled upon is the one that continues in use, even though it be very indirect and not the best or the shortest.

Animals learn mainly by trial and error. Their "intelligence" hardly transcends habits thus acquired. An elephant in the San Francisco zoo in 1936 was said to have "a trick of her own." She accepted peanuts from visitors, picking them up from the ground when thrown within her reach. Two iron railings with a narrow lane between them separated her from the visitors, and sometimes the peanuts thrown by them would fall in this lane beyond the reach of the finger at the tip of her trunk. When this happened she was said to blow them back to the sender by a puff of air through her trunk, as if in invitation to him to try another throw.

It is easy to see how, in reaching for distant peanut

pod and failing to get it, a chance snort might drive it back to the sender, leading him to throw it again, and how a few repetitions, all yielding satisfactory results, might have led to the habit and fixed the "trick."

The successive phases in the process of learning by the method of trial and error are these:

a) Unrest: unsatisfied desires, impelling to action.
b) Aimless efforts: doing something to relieve the tension.
c) Accidental success with consequent gratification.
d) Repetition of efforts, with concentration toward those that have yielded satisfactory results, and gradual abandonment of the others.
e) Fixation of methods: the establishment of reaction paths to be followed habitually in the future.

The essence of the training of animals is here. Among the acts that fall within the range of the animal's powers, the trainer provides rewards for those that he wishes to make habitual and punishments for those that he does not wish to have repeated.

The first way that an individual, man or beast, learns anything new is by trial and error—the hard, slow way. It is the only way in absence of instruction or example. It is the way we of the human species begin. Thus we learn to walk and to talk. What an extraordinary lot of useless and aimless sounds we make before we arrive at conversation, and what a long time it takes!

The progress of scientific research in entirely new fields is made by trial and error. In absence of any hints, or of past experience, there is no other way.

LEARNING BY IMITATION

Animals are little imitative. Learning to do as others do is so large a part of our education that it is difficult for us to realize how small a part it is of theirs.

My dog first convinced me of this. He was a handsome collie. For years he was accustomed to lie before my fireplace of evenings, showing unmistakable enjoyment of its warmth. My wife tolerated him because he looked well there. He matched her rugs. He saw me place sticks of wood upon the darkening coals many, many times yet it never entered his head, when the fire burned low, to put on a stick himself to keep it going: not because he couldn't; he could handle sticks very well with his teeth. It was easy for him to dig a big hole and bury a bone in the garden—a far more difficult and complicated task. But bone-burying was provided for in the make-up of his mind, and replenishing a fire was not.

Furthermore, when he shivered in his own house on a cold wintry night it was of no use for me to show him how to cover himself with a blanket; for, instead of getting under it, he would always get on top of it with all his feet, and after turning round a few times, lie down there. His turning about was like that of his wild ancestors when making a lair in the grass: it was instinctive behavior, inherited but now useless.

When he wanted to come into the house on a cold night, he would come to the door and give it a push with his foot, and I would hear the scratch of his nails and would go and open it for him and close it after him; but if the door chanced to be unlatched, so that he could enter

unaided, it never occurred to him to give it another push after entering to close it and keep out the cold. There existed in his mental organization no provision for such action. He could easily learn to fetch and to carry, to hunt and to herd; these were activities related to his past racial experience.

Animals have inherited aptitudes; each has its own. A cat gives no heed to most of the things going on around her, but the sight of a canary or the sound of a mouse brings instant alertness and readiness for action. These stimuli have a meaning for her, are related to her livelihood, and are the effective part of her environment. For her, most other things might as well be nonexistent.

Out of my study window I have watched a chicken and several juncos feeding together in a hedgerow on the seeds of a tall wild grass. The seeds were in dense chaffy spikes at the top of slender stems. The chicken was feeding rapidly by holding down a stem with its foot while picking out the seeds. The juncos were quite blind to the advantages of this method. Each one made a separate flight for each little seed obtained. Each flew up from the ground, seized the seed cluster in its beak, bore it down to the ground, and extracted a single seed; and every time the spike flew up again, to sway some eighteen inches above the ground. No bird ever set its foot on the stem to hold it down. No bird ever seized a seed while another held down the spike; but each bird made a separate flight for every seed obtained.

Animals very rarely learn anything by imitating others of their own kind. The elephant of the San Fran-

cisco zoo mentioned on page 105, stood side by side with several other elephants, all eating peanuts thrown to them by visitors. None of them ever imitated her method of getting lost peanuts. They were nothing advantaged by the trick she had learned.

In its beginning, imitation is very much mixed with trial and error. Learning to write, for example, is an imitative process; but if one watches a youthful learner, at the start he will be seen trying to guide his pencil blindly, making all kinds of lines by means of many kinds of movements of hands and shoulders and feet, with turnings of head and furrowings of brow. Slowly the curves are mastered, the proper muscles are brought under control and the useless motions eliminated. After a time it is no longer necessary to give thought to the movements of the pencil. Reaction paths become established: the curves run into words automatically, while the mind is concerned only with the thoughts that the words convey. Thus the uppermost seat of brain action is relieved of routine and released for the mastery of new undertakings.

Here is the great gulf that is fixed between us and the animals. We alone have the mind for doing as others do: our education consists largely in learning to imitate others.

This result accompanies the increase in the nervous mechanism that we traced in Chapter V, notably in the very large forebrain with its richer branchings of cells in the cortical layer, its large association areas, and its multiplied cross commissures between the hemispheres.

These are the phases of learning by imitation:

a) Doing with conscious effort, slowly and with difficulty.

b) Doing with moderate effort, while still conscious of the details of the operation.
c) Doing with ease, while quite unconscious of the details involved.
d) Doing automatically, conscious only of the objectives sought.

LEARNING BY EXPERIMENT

This method of learning is peculiar to the human species. We shall have little to say of it here, for our subject is man in his zoological aspects. We may note, however, that it is doing with regard to cause and effect, and that it involves both control of conditions and consideration of results.

Pure imitation is that of the oriental tailor, who in filling an order for a pair of new trousers, and being told to make them like the old ones furnished as a sample, strictly did so, even to putting a patch on the seat. Imitation and trial and error are intermixed with learning by experiment, but always there is something of judgment and choice superadded.

Animals may choose, in a way. My dog may choose between two well known paths by which to return home. But I do not believe that he will reflect on the ultimate consequences of his choice. In learning by experiment, consideration of the results of an action involves not only the immediate results but also the consequences that are more remote. Morality comes in here. This is the point at which (in the figurative language of the explanatory story near the beginning of the book of *Genesis*) it was

given to man to "eat of the fruit of the tree of knowledge of good and evil."

So we say again, the most peculiar thing about the human species is its behavior. Man is infinitely imitative, imitating everything. Man is commonly reflective, considering gains and losses, and the means by which they have been wrought. Man is occasionally inventive.

These are matters profoundly affecting the social order. They will be further illustrated in Part II.

Chapter IX

INFANCY

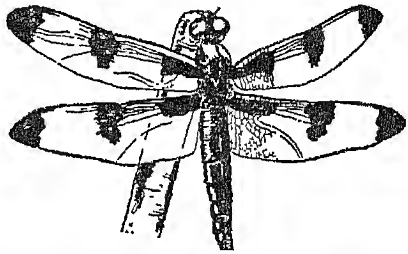
Structural differences between man and his nearest animal allies are not alone sufficient to account for the vast difference in activities and achievement. So we must look further. When we compare the developmental history of our species with that of other animals we find it distinguished by a remarkably prolonged infancy.[1]

The significance of infancy will be best seen in the light of its origin. Most animals have no infancy. On hatching they enter at once upon the business of getting a living for themselves. The struggle for existence they must wage alone, unaided. It is only in a few groups of highly developed animals that there is any parental care, groups that are more or less gregarious or social in their habits such as insects, birds, and mammals. Let us now see how infancy has developed in each of these groups (the term infancy being here used to cover the whole period of parental nurture). We will proceed as before by standing a few typical members of each group up in line for comparison.

In insects infancy has a wide range; degrees of progress in its development may be illustrated by these examples:

[1] It was a philosopher, John Fiske, and not a biologist, who first drew attention to the meaning of this difference.

1. The dragonfly, Libellula, scatters her eggs at random. She goes soaring over the pond, dashing down to its surface now and then to release her eggs in the water. She washes a dozen or more of her eggs from the tip of her abdomen at every descent. The eggs separate in falling through the water, and lie scattered about over the bottom, unprotected. There, after about a fortnight, they will hatch, and the little dragonfly infants will at once begin to shift for themselves.



A dragonfly.

2. The grasshopper provides her eggs with a nest. She digs a hole in the ground, places all her eggs carefully in the bottom of the hole, and surrounds them with a protective secretion that hardens on drying. There they remain in the shelter of the nest until hatched. Then they scatter and each looks out for itself.

3. The "mud-dauber" wasp both builds a nest and provisions it. She laboriously gathers mud from the brookside, carries it to some attic or loft, moulds it into about half a dozen cylindric cells stuck up against the underside of a board or rafter. Then she lays a single egg in each cell, provisions the cell, and seals it with a capping of mud. The food provided in the cells is ample for the full development of her young. It consists of small spiders, paralyzed with a sting but not dead. These spiders furnish a continuous supply of fresh meat.

4. The paper wasp builds a nest of thin-walled, paral-

lel hexagonal cells and lays an egg in each cell. This is the neat gray paper nest commonly seen pendant on a stalk beneath the eaves of buildings. She leaves the cells open until the eggs hatch, and then she feeds her young on prepared food, hourly or as available, until they are grown. The food she provides is a nice salad made by chewing aphids (plant lice), flies, or other small insects; and this she feeds them by hand.

5. The honey bee and many kinds of ants add to all this nurture the protection of society.

Thus we have a progressive series: eggs scattered at random, then eggs sheltered in a nest, then nest-provisioning, then hand-feeding, and finally social nurture.

Among birds we find a somewhat parallel series.

1. The megapods, or mound-builders, place their eggs in warm sandy soil and leave them there for incubation.

2. The grebe makes a sort of crude nest out of loose trash on the mud in a marsh. She lightly covers them with trash by day, sitting on them but nervously, and she quickly abandons them on the approach of an enemy.

3. The common hen, as everybody knows, makes a better nest, and gives herself up to three weeks of incubation of the eggs in it. Moreover, on approach of an enemy she defends it with vigilance and maternal fury. She has no help from the male who is her mate. On hatching, the young feed themselves under her further protection.

4. The robin and her mate together build a much better nest, and after the hatching of their callow nestlings, together feed them by hand until they are well grown.

Among mammals there is something of the same order of progress discernible.

1. Two exceedingly primitive mammals lay eggs: the duck-billed platypus and the spiny ant-eater, both of the Australian region. In all other mammals the young are retained in the uterus of the mother for a time before birth; and there is no definite hatching, for no shell covers them.

2. In the opossum and other Marsupials the young are born in a very immature condition. They are carried for a time in a pouch (marsupium), formed of a fold of skin on the belly of the female, where they feed on milk.

3. In all the higher mammals the young are more fully developed before birth, and feed for a longer period after birth on the mother's milk. These, however, differ markedly in the duration of nurture provided, as indicated in the following table:

COMPARATIVE DEVELOPMENTAL PERIODS IN MAMMALS[2]

Kind of mammal	*Prenatal period*	*Postnatal period*	*Life*
1. Mouse	3 weeks	3 months	4–5 years
2. Rabbit	4 weeks	8 months	8 years
3. Cat	8 weeks	1 year	12 years
4. Dog	9 weeks	2 years	15 years
5. Hog	17 weeks	3 years	30 years
6. Goat	22 weeks	2 years	12 years
7. Man	38 weeks	25 years	75 years
8. Horse	48 weeks	5 years	35 years
9. Elephant	104 weeks	20 years	100 years or more

[2] The prenatal period (gestation period, or period of pregnancy) is relatively definite. By postnatal period is intended here the time required after birth for attaining full maturity. This and the full life span are, of course, only approximate averages.

Within the limits of our own zoological order, the Primates, there are even more significant differences that lend themselves to arrangement in a progressive series.

1. *In the specters* (*Tarsius*) the young are born rather fully developed, and are carried about by the mother in her teeth, much as a cat carries her kittens. They are precocious infants, said to be able to clamber about in the bamboo thickets when two or three days old. They are cared for by the female only.

2. *In the lemurs* the young cling to the hair of the mother by hands and feet and are thus carried about. They generally cling beneath her body, tail forward, in travelling; they find more head-room to rearward. They hang on tightly while the mother goes leaping about among the tree tops. They are able to run about alone at the age of three or four weeks. They are cared for, by the mother only, for about six months. They are two or three years old before reaching maturity.

3. In the best known of the *Macacus monkeys* the infant is carried by the mother in her arms. It also clings to the hair of the mother. It is able to run about alone in two or three months. It receives maternal care for about a year, and attains full development in from three to six years.

4. *In the chimpanzee* the infant is carried in its mother's arms. It also clings to the hair of the mother. It can run alone in about six months. It receives some care from both parents for about three years, and matures in from eight to twelve years.

Thus we see there is a gradual approximation to the

conditions found in our own species. There are still differences; and one of them, though relative, is of vast significance: the retardation of development and consequent prolongation of infancy.

THE FLOCK AND THE FAMILY

Along with infancy has come the evolution of the family. Among the lower animals there is pairing, but no permanent mating. There is nothing like a family until we reach the developmental level of our household pets such as dogs and cats, or of our barnyard fowls such as ducks and chickens. With these the mother and her brood constitute a temporary family. She guards her infants until they are able to shift for themselves. She keeps them with her, finds them food, and protects them. The male takes no share in family cares.

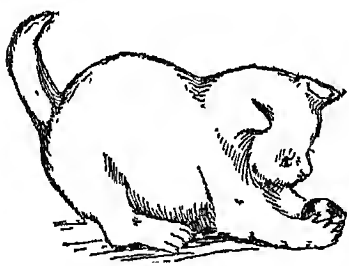
With these animals a period of maternal brooding is followed by a complete dispersal of the brood, when the mother drives her offspring from her. They scatter; and thereafter they seem to mean no more to her than do any other members of the flock. First there is maternal nurture, patient, brave, diligent, self-sacrificing even unto death, but purely instinctive, lasting only so long as there is absolute need. Then comes an entire change of attitude; impatience, repugnance, and personal hostility to her offspring appear as the maternal instinct wanes and the mating instinct supervenes. And the next mating may be with any male in the flock.

The permanent family has been evolved only with prolonged and increasingly helpless infancy, of such weak-

ness that the care of both parents for a long period is required for survival in the struggle for existence. That is the chief significance of the table on page 115.

Both parents share in the nurture of the young, and must remain together for that purpose. Moreover, with prolonged infancy and slow growth the young of successive births are kept together, and older and younger infants and youths develop side by side. This occurs only in man and a few of the anthropoid apes.

This is a factor in social progress of deepest significance. Relieved by parental care from the necessity of finding the means of livelihood, the infant has time to try out his powers and to learn their uses and their limitations. He has time to play; and play is preparation for business.



Play is preparation for business.

The young of animals play only at the things that are the serious business of their elders. The kitten plays at catching imaginary mice; the pup, at hunting and fighting and digging out burrows; but the child imitates everything, not only the work of his elders, but also the ways of familiar animals. In the water he tries to swim like a dog, like a frog, like a duck, like a seal; and then he adds new ways of his own devising. Thus he learns initiative while cultivating his powers of imitation.

Doing these things while in close association with the members of his family, he profits by the example of others;

he profits by instruction from others; he profits by cooperation with others; and he learns to work with others.

The young of the great apes profit similarly by this youthful association, as has been observed by Doctor Yerkes in his colony of chimpanzees. He says:

"It is not until childhood that the little chimpanzee escapes the surveillance of its mother, dares to face the unexpected and startling events of the world and to live aboundingly in the company of its juvenile peers. Thenceforth and increasingly child learns from child, and social contacts become more varied and exciting as well. The playful personality speedily emerges, together with those social behavior patterns which later will determine the place and relations of the individual in the social order."[8]

Again, the superiority of *Homo sapiens* is merely relative. Only this may be claimed as distinctive of the human *infant:*

It is helpless beyond all others—more undeveloped at birth.
It is witless beyond all others—has fewer developed instincts at birth.
It requires care beyond all others—nurture both by parents and by society.
It is slow of development beyond all others.
It acquires powers beyond all others—mental powers.

It is the testimony of all biology that nurture pays. Giving the young a good start in life, equipping them well

[8] *American Naturalist* 73: 106, 1939.

for the struggle for existence, means security for the species.

The maximum of physical nurture in the plant world is found among the seed plants. In the seed itself we find a reason for their dominance. The seed is a young plant already started in development, supplied with a rich store of food to help it further on its way, and encased in protective seed coats. In competition with plants thus nurtured, what chance have liverworts and ferns and others that must start alone from microscopic spores? We look about and see the landscape filled with the seed plants; we find the spore-bearers by searching in the nooks left over, in the situations that are less desirable for the growth of vegetation.

The maximum of physical nurture among animals is that of the mammals—nurture by means of embryonic membranes (to be briefly noticed further in the next chapter), and mammals dominate the animal world. To this physical nurture a few of the social animals have added parental care and a measure of protection by society.

Nature has taken adequate care of early development up to the time of birth. She has also provided parental instincts that lead to provision of proper food and shelter afterward; but she has provided only enough nurture to insure that each individual shall enter the world a well-equipped animal. She has gone only far enough to indicate the way of progress.

Man has discovered that nurture pays, and that mental nurture pays best. And what is more important, he has seen that it is this mind-developing nurture that is

most amenable to his control. He has sought to extend it by cooperative enterprises, by schools, by books and newspapers, and by all the educational devices of civilization.

Thus human infancy, considered in the large, is further prolonged. In the eye of the law it takes twenty-one years to make a man. And I doubt not that there will be among the readers of these pages a goodly number who, after passing the age of twenty-one, were still the occasional recipients of nourishing bank cheques from home.

THE HUMAN INFANT

If we now take a glance at human development in the large we shall better appreciate what a long rough road man travels through embryonic life, infancy, and youth before maturity is attained. In the course of his development he must be:

1. At origin, a single cell, the fertilized egg cell.

2. At a few hours development, a sphere of cells that have resulted from the successive divisions of the egg cell.

3. At about ten days development, a coelenterate animal in body plan: with the primary cell layers all developed, with an inner food tube (gut) begun, an outer body wall, and with a body cavity developing between the two.

4. At four weeks development (fig., p. 13), a primitive vertebrate, with gill arches developing in the sides of the throat, with a notocord (the primitive type of skeletal rod that precedes the development of the bones of the spinal column), and with the brain and spinal cord developing together as a long neural tube upon the dorsal side.

The gill apparatus and the circulatory system are as yet more fish-like than mammal-like in plan.

5. At six weeks development, a primitive mammal in general features, having preserved the left aortic arch while losing the right one (as is well known, the lower vertebrates keep both, and the birds lose the left one), and having two condyles developing at the base of the skull.

6. At two months development, a generalized Primate, with hands and feet developed much alike, both thumb and big toe being set off from the other digits as if in fitness for grasping, and with a short tail.

7. At three months development, obviously human, hand and foot being differentiated, also the ear and chin having appeared, and the upper brain having attained to proportions larger than that found in any animal.

8. At birth, still an unfinished creature: blind, deaf to ordinary sounds, helpless, the upper brain not yet functioning. The spinal reflexes are well developed and the control centers in the lower brain that are necessary to keep life going are all on duty. The sense of touch is developed, and probably so are taste and smell as well. All activities of the newborn infant are purely automatic. They are performed without any direction or control. They involve every muscle in the body, but they act without any selectivity or purpose.

The human infant at birth is a bundle of anthropoid characteristics, the more obvious of which are the following:

a) A "shell back" with a single curvature of the spine.

b) A narrow chest and a slumping posture.

c) A low forehead.

d) A snub nose, with nostrils directed forward.

e) Long arms and short legs, proportioned about like those of a chimpanzee.[4]

9. At about three months after birth, the control circuits of the upper brain begin definitely to function, with some voluntary control of muscular activities. Eyes and ears may then respond to things in the environment that are beyond the reach of hands and tongue.

10. At about six months after birth, the human infant is a little quadruped going on all fours. With the mental life awakening and the voice brought into the service of the brain, he begins to play at anything and everything during waking hours. But he is greedy, selfish, unfeeling for others, conscienceless, and at the very best, a healthy little animal.

Beyond this, development is less uniform but more human. At about the age of eight years, brain association-paths seem to be most rapidly established. That is said to be the age at which arbitrary things, like languages, the multiplication table, and English spelling are most easily learned.

In adolescence the emotional nature develops most rapidly, and the purposes that will motivate later life then become rather firmly established.

[4] Ratio of arms to legs in length in a few of the higher Primates:

Orang	140 : 100	Adult Pygmy	83 : 100
Gorilla	118 : 100	Adult European	67 : 100
Chimpanzee	104 : 100	Infant European	104 : 100

The upper brain, which, biologically speaking, was late in arriving, may go on to better functioning after the peak of physical development is passed. Here individuals vary greatly. For some there seems to be small capacity for mental growth beyond the age of puberty, but happily there are many who are able to enter the intellectual heritage of the race and to keep on enriching it through the whole of their long lives.

Chapter X

NATURE AND NURTURE IN THE HUMAN SPECIES

Two sets of factors enter into the making of every individual: internal forces and external conditions. The living substance is ever doing things in and of itself, following innate hereditary tendencies: these are its *nature*. The food and the shelter and all manner of sustenance, both physical and psychic, that environment provides constitute (in so far as they may be expressed in one single word) its *nurture*.

NATURE

The nature of an animal is its hereditary endowment. This is determined when egg and sperm have fused. In these two sex cells the two parents have contributed equally though diversely to the character of a new individual; and, later, nothing can be added to or subtracted from this basic endowment. All that nurture can do is to provide conditions that will permit the development of what is already potentially present in the fertilized egg cell.

A hen by sitting on duck's eggs can never hatch anything but ducks out of them; for there is nothing but duck in them. An incubator may be substituted for the brooding hen: brooding is a part of nurture. Nothing

can take the place of the germ cells; there is no other starting material.[1]

Early in the development of the body from the egg there occurs a differentiation of the growing cell mass into the two parts that Weismann properly emphasized as "germ plasm" and "body plasm." The germ plasm is a group of cells that will remain unspecialized, that will be segregated within the developing body, and that on the approach of the maturity of that body will produce new germ cells for another generation. They take no part in the labors of the body. They serve no other function than that of reproduction; but they alone leave descendents in future generations. They are thus potentially immortal.

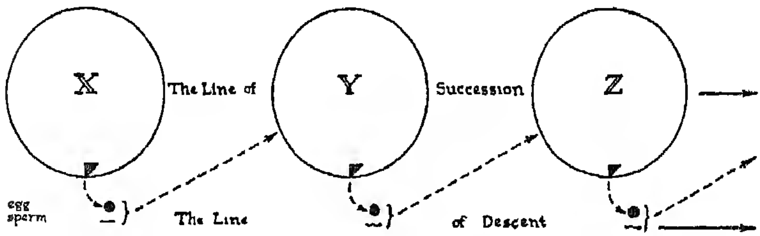
After the germ plasm is set apart, the remaining cells of the body that make up the body plasm increase to a vast multitude, differentiate into tissues and organs, and become the perceptible bodies of persons. These cells are organized for business, the business of living; but all are mortal, like the body they compose. Such is the make-up, and such the history of the body of a person, as indicated in the long-familiar diagram of three successive generations herewith shown.

[1] Once at a mother's congress I was invited to discuss heredity. I emphasized its basic nature, but with little effect on at least one good lady in the audience, for in the discussion that followed, she got up and asked leave to read an original poem, the first line of which ran:

"A weed is but a neglected flower."

(that is all of it that I can remember, except that there was a fine plea in verse for better nurture). Her purpose was good, but what she said in that first line could not have been more false; for she surely knew, as everyone knows, that all that can be made out of a weed by care and culture of it is just a fine specimen of a weed.

The germ cells, and they alone, are the bond between the generations. In them is the line of descent. The basic explanation of physical inheritance is here. Parents and offspring resemble each other because both are derived



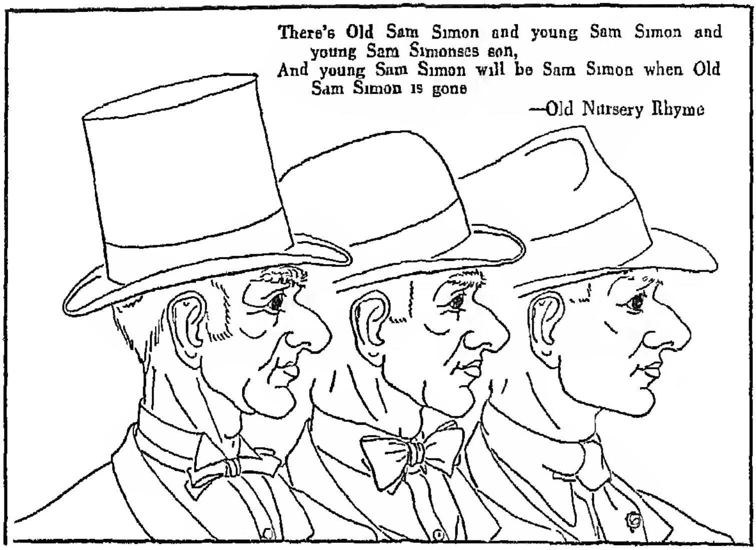
A diagram of the relations between germ plasm (solid black) and body plasm in three successive generations. X, Y, and Z are three persons.

from the same original stock of germ plasm. Persons as we know them constitute merely a line of succession. They are the bearers and the custodians of the germ plasm.

The germ plasm is the part of us that nature guards in the most miserly fashion, sequestering it from contact with the rough world, and keeping it thus from generation to generation little changed.[2] On the other hand, body cells share in the struggle for existence. They buffet the world and often bear the scars of combat; and they die inevitably when their course is run and their work is ended.

The germ cells do not struggle: they only reproduce their kind, and wait.

[2] "Every grandfather [in China] seeing his grandchild going to school, feels that truly he is living over again in the life of the child. His own life is nothing but a section of the great family stream of life flowing on forever."—Lin Yutang in *The Importance of Living.*



Hats change, but noses go on forever.

NURTURE

In order that the potentialities resident in the germ cells may be realized, nurture is necessary. It varies enormously in different animals, being scanty in the lowest of them and most extended in our own species. It appears in various forms, as indicated below:

Types of Nurture

I. Shelter

A. Internal

a) Sequestration of the germ cells within the body in ovaries and spermaries.

b) Protection of the developing embryo within the body of the mother.

B. External

c) Nests, burrows and housing.

II. Sustenance

C. Physical

d) By means of yolk: food that is stored in the egg.

e) By means of embryonic membranes that take up food for the embryo from the blood of the mother.

f) By milk glands.

D. Psychic

g) Parental care and training.

h) Social nurture.

A few words will suffice at this point concerning the two principal types of physical nurture, yolk and embryonic membranes. Yolk is stored in the egg previous to fertilization. There is little of it in the minute and transparent eggs of many of the lower invertebrate animals; and again there is little of it in mammals—in mammals the feeding function has been taken over by embryonic membranes—but there is much of it in the eggs of all the other vertebrate groups. The egg being a single cell, yolk sometimes distends it enormously, as in birds and reptiles, in which groups it reaches its maximum size. The egg of an ostrich may weigh three pounds, and the fossilized eggs of certain prehistoric birds were much larger. The amount of food thus supplied to the developing embryo determines the size to which it may grow before it must find other forage.

Another plan is followed by the mammals—that of retaining the egg in the uterus of the mother and feeding it there by means of embryonic membranes. The human

egg contains so little yolk that it is almost entirely transparent, and is so small as to be barely visible to the unaided eye. It is fertilized internally somewhere in its passage outward from the ovary. Then it becomes lodged against the wall of the uterus, where a development begins that results in its attachment to that wall.

The processes whereby it attaches itself and develops the feeding organ known as the placenta are far too intricate for us to attempt to describe them here. There are, however, a few general features that everyone should know, for they are a part of his own personal history.

After fertilization the human egg divides repeatedly and first forms a little sphere of cells. With further division it soon differentiates two layers of cells: ectoderm and endoderm, the same that we found making up the body of the hydra (p. 51). Between these two cell layers there develops a third called mesoderm that was not found in the hydra but that is present in all the higher animals from worm to man. Then these primary cell layers go on producing all the organs of the body, each producing the same parts in all vertebrate animals alike.

Lacking yolk supply the embryo must needs develop another means of getting nourishment. This is that method in mammals: a membranous covering called the chorion develops over the back of the embryo, and expands and extends downward and closes around it and shuts it in. Thus the embryo (or *foetus*, if the more special term be preferred) is shut up in a little world of its own, apart from the mother although sheltered within her uterus, and so will remain until birth. The enclosing

sac is a membrane that secretes a fluid (the amniotic liquor) in which the little body floats.

The inner germ layer, the endoderm, takes the initiative in developing a special membranous feeding organ. It grows out to rearward in a hollow more or less tubular or bag-like process, the outer end of which is applied to the inner surface of the chorion at a place where that sac rests against the uterine wall. Blood vessels grow out from the body of the embryo to this membrane, and at its outer end they become richly branched, forming there a dense capillary network. At the same time the wall of the uterus becomes abundantly supplied with blood. The membranes of the embryo, and the wall of the maternal uterus become adherent, and together they form the placenta, a feeding organ that is peculiar to mammals (see figure on page 13).

The placenta is thus seen to be composed of the parts of two individuals belonging to different generations. In it there are two circulating blood streams, side by side but not confluent: that of the mother in the uterine wall and that of the embryo in the attached portion of the embryonic membranes. The two blood streams are separated by walls so thin that exchange of substances in solution in the blood readily take place between them. The blood of the mother brings food and oxygen to her offspring, and takes away its carbon dioxide and other waste products. The blood of the embryo takes up in its passage through the placenta and carries to its tissues all the material necessary for growth, and delivers its wastes to the maternal blood stream for removal.

The placental blood vessels of the embryo together with the enveloping membranes become drawn out into a stalk that is the umbilical cord. Its attachment is to the middle of the belly, where the navel scar will remain permanently after birth.

Here then are two separate persons. There is no nerve or blood vessel extending from one into the other. The relations existing between the two are those of nutrition and protection; from which it follows that the tales everywhere current about "prenatal influences" and their baneful effects upon the developing infant are mythical. Harm can come to it from the mother only through disturbances of her health and through harmful substances or parasites introduced from her blood. The little embryo, floating in its amniotic bath in the security of the maternal uterus, is wonderfully guarded by nature, and free from the buffetings of a rough world. Thus it lives through the entire period of pregnancy, until at the end it hangs on the cord like a ripe fruit upon its stalk, ready for detachment.[3] Detachment comes at birth. The cord is severed; placental circulation stops; air is taken for the first time into the lungs which are ready for instant service although they have had no work to do before. Then another element of mammalian superiority comes into play: the milk glands of the mother provide a new food supply of a most wholesome and satisfying sort. Thus, to the highest brain development there is added the maximum degree of physical nurture; and we mam-

[3] A readable account of intra-uterine development will be found in Mrs. Margaret Shea Gilbert's *Biography of the Unborn*, Baltimore, 1938.

malians of the human species are among the beneficiaries of it.

Further nurture goes with the development of the social order.

Now we have taken a look down the long vista that the science of biology opens to the imagination. At the farther end is formless protoplasm, moving with the first thrill of responsiveness to the conditions of the world around it. Along the way are ranged all the acquired powers and all the form changes of the past. At this end is a wonderful assemblage of living forms; plants and animals in infinite variety; among them, ourselves, with a mind that contemplates all, and endeavors to understand all—and withal, itself.

The living substance throughout is protoplasm; seemingly one substance, alike in all, and yet in the course of its onflow, marvelously dispensing to every individual some mark of his own that no other individual in all the world possesses. Protoplasm organizes itself in cells, its working units; and behind the cells that build our bodies, that do the work of our bodies and of our minds, is the great mystery of life itself—the driving power of an unexplained control that shapes the course of cell development in the individual, and carries on by cell lineage through successive generations.

Part II

SOCIETY IN ITS BIOLOGICAL ASPECTS

Chapter XI

POPULATION

Population is largely a matter of breeding and feeding. These are the two basic enterprises of life on which the continuance of the species depends and to which all other things of necessity adjust themselves.

QUALITY

Since the units of population are persons, it is obvious that the basic need is for soundness of body and mind in those persons. There are two sets of factors entering into the making of each person, inherent tendencies and environmental influences; and there are likewise two schools of opinion as to means of social betterment. The programs that they offer bear high-sounding Greek names:

1. *Eugenics,* looking to nature, to better breeding.
2. *Euthenics,* looking to nurture, to better environment.

Eugenics takes the longer view: points out that the human species inherits as do the animals, that the germ cells are the bond between the generations. Eugenics rightly claims that however much the young may receive of fostering aids (in yolk, in shelter within or without the body and nourishment, in parental care and training),

when egg and sperm have united it has already received its full hereditary endowment. All that nurture may do is to develop the powers already potentially present. Thus eugenics seeks to deal with the basic materials of population, and looks toward betterment of stocks.

That there is need of betterment in our own time is painfully apparent, for many of the unfortunate weaklings of our race are perpetuating their weaknesses in their numerous offspring. They tend to overcrowd the lower ranks of human society. The classes that are most advanced in arts and education are hardly reproducing themselves, while the ranks are being filled with the descendants of the less progressive.

I once took a partial census of the population on two streets of a college town that I will here call Smithville. One of these streets, here called High Avenue, was in a residential district near the college: the other, Low Street, was in a factory district, with a population mainly of foreign immigrant laborers. On High Avenue several of the largest families had four children; in a number there were no children at all; and the average number of children per family was one and one third. This was a loss of 33 1/3% per generation. On Low Street the average number of births per family was eight. Half of the children had died in infancy, leaving as survivors four per family—an increase of 100% per generation. The effect of rate of breeding on human population may be made very clear by using the above figures for illustration. We will assume that these two classes in Smithville society remain apart and continue to rear children as detailed

above with one class losing a third and the other doubling its numbers in each generation. There being in Smithville about twenty-seven times as many people in the High Avenue class as in the Low Street class, we should have:

In the first generation a ratio of					27 : 1
In the second	"	"	"	"	18 : 2
In the third	"	"	"	"	12 : 4
In the fourth	"	"	"	"	8 : 8

Equality of numbers reached in four generations!

Happily this will not occur in Smithville, for the difference between the two classes is not in the nature of the classes but in their nurture. America is still a land of opportunity. The children are in school. Those who live on Low Street will acquire education and property; some of them will in a few years move up on the Avenue, and become sterile too.

That the educated classes are not taking a larger share in the building of the population of the future is not in itself necessarily an evil, for education is not always an accompaniment of either physical or moral fitness. Indolence and self-gratification and the cultivation of low desires breed degeneracy in rich and poor, in ignorant and learned alike. That the population in the near future will be composed mainly of the sons and daughters of poor and ignorant parents is not so serious a matter as might at first appear; for with normal aspirations, property and education may be acquired, and the lack of these may be due to accidents of birth and station. The danger of qualitative degeneration lies in the rapid and as yet almost unre-

stricted breeding of the physically, mentally, and morally degenerate.[1]

The approach to the problem of bettering human stock is very difficult. The measures that have been tried hitherto are mainly negative in character. They have to do with preventing the increase of the most defective, rather than with the selection and increase of the best.

Segregation of the sexes in asylums and other institutions is almost the only measure that bears the stamp of general approval. It fails, because the defectives are so numerous that provision for long segregation of all of them is beyond the financial resources of society.

Sterilization of defectives is another negative measure that is being applied in a small way. A comparatively simple surgical operation (the removal of a portion of the ducts of the sex organs, sperm ducts in the male and oviducts in the female) renders the one operated upon incapable of producing offspring. Although this operation is done for social betterment, safeguarded by many restrictions, and sanctioned by law, many deem it an inhuman practice. It lacks the support of tradition.

Positive measures for bettering human stocks are still almost entirely lacking. The selective breeding methods of the stock pen are not applicable to human kind. The scientific selection of mates is not possible, because not wanted, and because knowledge is lacking to guide such selections with assurance of desirable results. This is where eugenics goes lame.

[1] This paragraph and several others are taken with slight alterations fror the author's *Survey Course in General Biology.*

Fortunately or unfortunately, the springs of racial progress lie very deep; and if they are not easily reached by humanitarian effort, they are at least free from unskillful meddling.

Euthenics, dealing with environment, may proceed with greater confidence. The social heritage, unlike the biological, is amenable to direct control. The euthenist may rightly claim that whatever gifts the individual may inherit, only proper nurture can bring them to perfection.[2] There are conditions existing in our civilization that select the best for elimination: wars, that kill off the strong and the brave on the battlefield and leave the weak at home to breed; economic conditions that take the brightest of the children from their studies and their play and set them prematurely at grinding toil. Too many die in their youth, and there is a vast wastage of costly nurture involved in their broken lives. In euthenics lies our hope of early betterment. Its ideal is the well conditioned development of everyone born into the world.

When we come to positive measures for bettering the breed there is little to report. A few public measures for increasing the size of families have been tried, but they have been mainly nonselective as to quality. Bonuses for having children are not unheard of. The income tax exemption is, in a way, a meager reward in that it carries

[2] Perhaps in this neglected spot is laid
    Some heart once pregnant with celestial fire;
Hands that the rod of empire might have swayed,
    Or waked to ecstacy the living lyre;
But knowledge to his eyes her ample page
    Rich with the spoils of time did ne'er unroll."
—Thomas Gray, in *Elegy Written in a Country Churchyard*

a small exemption for dependent children. It applies, however, only to those who possess enough property to require the payment of a tax; and thus the possession of money, rather than the quality of the man, is the basis on which it operates.[3]

NUMBERS

One of the basic and obvious facts on which Darwin based his explanation of the method of evolution was that in every species more young are born than can possibly survive. Species differ remarkably in the number of their young but they all agree in the tendency to increase at a geometric ratio. The offspring of a single parent may number millions or may be but a few individuals; but in either case if all survived to increase in like ratio, the earth would soon lack room for their progeny.

The numbers are very great among the lower animals, Single oysters, for example, lay millions of almost yolkless eggs. They provide no further nurture for their young. They merely breed. Their innumerable offspring are scattered broadcast in a pitiless environment, and here and there by chance one survives. Destruction is the rule; survival, the rare exception.

A pretty little pond-inhabiting mayfly, *Callibaetis*, that I once studied at Ithaca, N. Y., is only moderately prolific, as animals go. Each female may lay about 1000 eggs. Should all the eggs of all the females survive to

[3] When I was making out my first state income tax return, my little daughter was standing beside me looking on. I said to her "Honey, this is the first time I ever knew you to save me money; but I wouldn't agree to raise another girl like you for the state of New York for sixteen dollars a year."

reproduce in their turn, the possible increase (half of them being males) would be as follows:

Present generation	1 pair;	offspring	1 000 eggs
2nd "	500 pairs;	"	500 000 "
3rd "	250 000 "	"	250 000 000 "
4th "	125 000 000 "	"	125 000 000 000 "

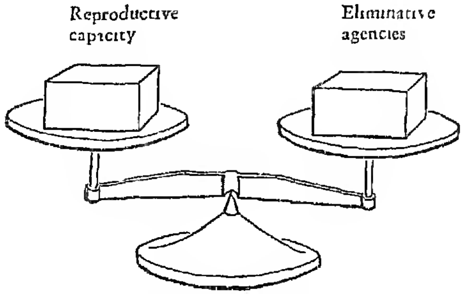
and we should soon have more bulk of mayflies than of water in the pond.

What actually happens is that these mayflies merely hold their own, maintaining (within the wide limits of annual and cyclic fluctuation) a fairly constant population level; which means, obviously, that out of every batch of eggs, two on an average survive to lay more eggs.

Three pairs of offspring in a lifetime of 100 years is said to be the rate of reproduction of the African elephant—a rate phenomenally slow; yet even this is an increase of 200% in a century, sufficient if maintained without losses except from old age, to cover the earth with elephants.

By excess of births nature provides for inevitable losses. The excess is proportioned to the dangers to be encountered in life. Population under primeval conditions holds to a general level that is commonly designated by the term "the natural balance." As illustrated in the accompanying diagram, the balance is between reproductive capacity on the one hand and eliminative agencies on the other. The latter are (1) physical conditions (extremes of heat and cold, tempest, flood, etc.), (2) predators and parasites, and (3) competitors: competitors for

food and shelter, first of other species, and then of the same species.



The natural balance

The Balance of Nature is a swinging balance, easily upset, and hardly ever at rest. Evidences of its disturbances are ever at hand. One may see by the roadside almost any season a host of starving caterpillars on a bush that they have entirely stripped of its leaves. And then one may reflect that too many caterpillars on a bush is a condition that is not good for the bush; neither is it good for the caterpillars. Like all overpopulation, it not only kills in the present, but it also impoverishes for the future.[4]

What the birthrate for the human species was in primeval times we do not know, but doubtless it was high, possibly between ten and eighteen per family, and it was matched by a correspondingly high death rate. Some thinking has been done on the causes of the deaths, and ways have been found for preventing many of them. Man has safeguarded his health from dangers of heat and cold, wind and rain, and other physical eliminating agen-

[4] Professor I. P. Roberts, first dean of the New York State College of Agriculture, used to say to his classes in agronomy, "The worst weed in the cornfield may be corn", meaning too many stalks in hill, overcrowding, resulting in severe competition for sustenance and failure to produce a crop.

cies by means of clothing and housing. He has overcome his enemies big and little by various devices: first, the great beasts by means of weapons; last, the germs of disease by means of scientific research. He has lessened competition with other species by destroying them, and with members of his own species by the development of a vastly increased food supply.

Modern conditions demand further thinking on the population problem. The rate of reproduction established by nature for the human species is far too high for civilized conditions. It was adequate to replace losses by war, pestilence, and famine in primeval times. Now that the former agencies of death are in a measure controlled, the balance is disturbed badly. Without these checks the human population of the earth is rapidly increasing.

Many wild species are being exterminated, and most of them are being reduced in numbers; for man must carry with him the few domesticated species on which his livelihood depends. Wherever he goes the native population must be annihilated to make room for his fields and stock pens.

Every triumph of science over plague or casualty increases the pressure so long as the excessive rate of increase continues.

Behind all this crowding is the nature of man, with the irresistible sex urge. Abetting this urge is the demand of war-lords for larger families—more men to man the guns—more men for cannon fodder. Also there remains the primitive feeling that the nation is strongest that has the largest population. Obviously this is no longer true.

It is not cannon fodder that is needed—not mobs that consume food and get in the way—but a reasonable and adequate number of capable men, well equipped and trained in the use of the best scientific equipment, and minded to use it in defense of human welfare.

Nature's inexorable limit is set by the food supply. Mankind must eat to live. Every advance in food production is quickly overtaken by increase in population. Generally the optimum is soon overpassed, with men as with caterpillars, and starvation sets in to reduce the excess.

Millions of people in various parts of the earth are living today at the bare level of subsistence. Too many mouths to feed is the basic trouble. It has been so from the beginning of human history; seeing which, some very brutal methods have been used to keep the numbers down. The killing of a portion of the female infants at birth was long practiced among savage tribes; the killing of foetuses before birth (abortion) has been a world-wide practice that is still too prevalent in our own time.

With the advance of science there has come better knowledge of the nature of the reproductive process and of means of its control. This knowledge has provided humane methods for limiting the excess of births; but birth control came in as a new idea. It had to win its way against a full tide of stubborn tradition and legalized obstacles. The poor have long been kept in ignorance of the best means of alleviating their distress and poverty.[5]

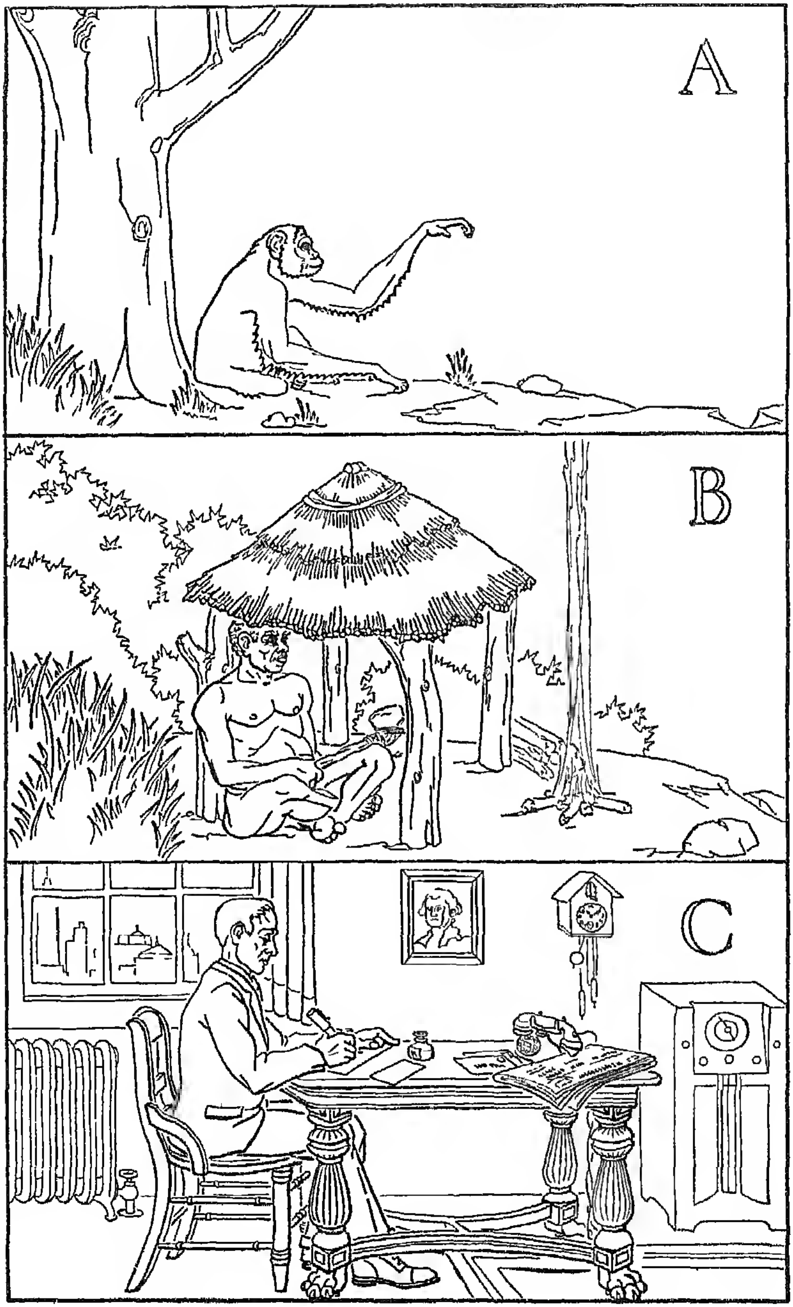
[5] "Studies in widely scattered areas in the United States show that the birthrate among families who have been on relief [sustained by public funds; 1936] for more than a year is about sixty per cent higher than among families of similar social status who are not on relief."—James S. H. Bossard, in *Birth Control and Continuing the Depression.*

Slowly it has come to be recognized that ignorance is no more a virtue here than in any other field of human interest. There need be no fear of "race suicide," for nothing is more deeply anchored in human nature than are the parental instincts. All men and all women love children. Even the most depraved person will deal tenderly with a little child. Gentleness came into human life by way of the helplessness of infancy. It is children that give meaning and purpose and hope for the future to family life.

For any given set of environing conditions there is an optimum number of persons that can be well maintained. That number should be the objective set for population control.

Philanthropy sometimes falls short of its aims because of blind adherence to roseate theories that are based on noble sentiments rather than on cold facts: it does not look far enough ahead.

The direct road to racial deterioration runs by way of continued breeding from inferior stock. The evil of it is less apparent than that wrought by wars and panics: it works more slowly, and is more insidious; but it is far more lasting. Devastated cities may be built again by renewed labor, and lost fortunes may be reestablished by thrift and industry, but the powers of mind and character eliminated by bad breeding may hardly be restored. Of all the wastage that wars entail the wastage of human lives is most serious, for that loss is irretrievable. Surely unlimited breeding from defective stock should not be allowed to go on crowding the earth beyond endurance and filling the land with stagnation and misery.


A
B
C

Chapter XII

SOCIAL NURTURE

Let us begin consideration of social nurture by visualizing its consequences as pictured in the accompanying diagram in which *A* is an ape, *B* is a barbarian, and *C* is a modern city man.

The ape *A* eats only raw food. He has no clothes, no fires, no tools, no weapons, no house, and no crafts. He has no mind for such things.

The barbarian *B* cooks some things to eat, but his diet is not very different from that of *A*, or for that matter, from that of the bear that is his competitor for food and shelter. He has hardly more than *A* in the way of clothing and housing. He has no soap, no money, no wardrobe, no pantry. He has only the crudest of weapons and tools. He lives as a freebooter, picking wild things to eat, and cultivating nothing. He is less provident than the bee or the squirrel, and far less industrious. He eats like an animal when hungry, and waits until hungry again before setting out to find more food. He lives in a small world and has little society, for without any agriculture food is scarce and population is necessarily scanty. His world is peopled by his own imagination with supernatural beings, with spirits that are mostly evil, that have frightful

powers to harm, and that must be propitiated by sacrifice or controlled by magic.

But he knows how to start a fire, and he uses the fire for shaping crude weapons. He is a world phenomenon—a tool-using animal. When he has sharpened the point of a broken marrow bone to make a dagger of it, he has quite outdistanced *A*.

The city man *C* is a modern educated gentleman of any of our populous centers. He has soap[1] and a bath tub. He has matches to expedite his fire-making. He builds fires in stoves and furnaces and kilns, and in strange little receptacles that he carries underneath his nose. He has perfume on his handkerchief and "slickem" on his hair. He has push buttons and zippers. He sets his words down in black and white by means of a fountain pen or a typewriter. He cultivates style, and acknowledges loyalties, and follows flags. He does not sit on the ground.

Looking again at the three in the picture, one is first struck with the vast difference in estate between *B* and *C*. It seems greater than that between *A* and *B*, but it is not so in fact; for the difference between *A* and *B* is a difference in nature—inborn, inherent, it is a difference of kind. That between *B* and *C* is mainly a difference in nurture; it is extraneous, and due to age-long differences in environment.

The three, *A, B* and *C,* have zoological characteristics that are quite alike: they have the same structures even down to microscopic details; the same bodily functions

[1] One of the world's great inventions: all that is needed for proof of this is a little contact with those who do not use it.

and physiological reactions; the same manner of birth and of development; the same appetites and instincts. They have not the same brain. No one has suggested that we send missionaries to convert the apes to our way of thinking. It is evident that *B* and *C* have psychic needs far beyond those of *A*. They have greater curiosity, better powers of imitation, more initiative, a livelier imagination, a more pervasive vanity, and a greater capacity for vexing their souls about imaginary evil spirits as the cause of life's ills.

Although *B* and *C* appear so different, we have no reason to suppose that such great differences would exist if each had lived his entire life in the environment of the other. We may not assume that a great sculptor like Michael Angelo had any more natural gift for art than had the first savage who with a blade of flint carved a picture on the shaft of a bare bone; but he had better tools and a long training in their use; and he had a good background of artistic tradition, and a measure of public support.

There is nothing revealed by measurement of cranial capacity to indicate that modern men have better brains than had the best men of the old stone age. The difference is mainly in their social nurture.

BEGINNINGS

Unwritten human history begins with men like *B* of our diagram, living in comparative isolation in small family groups. Their first needs were for food to eat and for places of security in which to dwell. Finding food

enough to keep life going in times of scarcity was the biggest problem of livelihood. They probably dwelt in the tropics along with the other Primates. Living is easier there than in colder climes; clothing is less necessary; fruits and roots, eggs and oysters and other raw foods are available the year around.

In the beginning man, the barbarian, could do nothing to improve his environment except what he found out how to do for himself; for he started at a "cultural zero." He parted company with the animals when he invented language. When he had learned a new trick, words enabled him to transmit suggestions of it to others. He could tell others how to do it, and they could pass the word along. Thus culture was born.

Let us speculate a little as to the steps in progress that followed. How did he find out how to start a fire? He may at first have noticed how a wild fire spreads, may have spread it himself, and thus learned something about kindling. He may have brought it to the door of his hut or cave to ward off nocturnal beasts of prey. Sooner or later, by accident or otherwise, he discovered how to start a fire by rubbing sticks together. Earlier he may have seen the improvement that is made in foods by cooking them. Cooking is the most important of all uses of fire, for it makes available a vastly increased range of foodstuffs. Roots and grains, fish and fowl, that were inedible before, became not only usable but healthful and delicious after cooking. When fire was brought indoors, the hearthstone was established, and the word fireside has since been synonymous with home.

Doubtless he soon discovered that fire has other uses. With its aid he could shape a club that would have a longer reach and a heavier stroke in battle than bare fists. With fire he could harden the point of a light spear, one that could be thrown to reach an enemy at a distance. A further great advance in projectiles came when he invented the arrow with the bow to propel it; for the range of the arrow was greater than that of the spear, and it could be shot with more precision. It was light and quickly made and easily replaced if lost. It was swifter than the wings of a bird or the legs of a deer.

Bow and arrow are among the greatest of history-making inventions. For a very long time they were used the world around. Until the invention of gunpowder the arrow was the world's chief weapon; and its name gained a permanent place in our language as a symbol of swiftness and directness and piercing power.

Man's fondness for meat to eat made him first of all a hunter. Eggs and oysters were about the only animal foods that nature offered ready made and that needed only to be picked up. If he wanted meat, he had to get it by the use of his wits; for game animals were well armed, swift of foot, and elusive. Their capture demanded deft hands and a resourceful brain. He must catch his rabbit before cooking it. His wits were matched against animal cunning. He invented traps and snares. Also he had to learn the ways of animals before he could catch them. In all this there was very fine mental training—training from which in modern times we are very far removed. We now seek in a small way to regain some of it by renewing primeval experience in camps and vacation outings.

The dog was man's first animal helper. When hunting was his chief occupation the dog lent him the invaluable aid of his keenness of scent, his swiftness of foot, the strength of his well-armed jaws, and—most important of all—his capacity for cooperation in securing meat for food.

We can only conjecture how agriculture began; there are no written records. We may easily imagine that it was with the planting of a few roots or seeds of things good for food. The planting of a root is not very different from the digging up of one, and the doing of it only awaited the mind that was able to take a hint from nature and imitate her ways. The selection of the best that nature offers, followed by care and culture of the things selected, is the essence of agriculture.

The domestication of animals may have started in an equally simple way. Many wild animals are tameable if taken young enough, and children everywhere like to have them as pets. Colts and calves and lambs need only a little care and kindly handling to tame them. It might well have been that in some time of famine such pets as these provided a reserve food supply, and that more of them thus came to be reared as provision for future needs.

When some of the tamed animals reared their young in captivity, then a more permanent association began. Herds were started, and a more dependable food supply was assured. In settling these animals about his place of residence man settled himself there, and ceased to be a wanderer on the face of the earth. He built himself a permanent home, and the general welfare was established on a new economic basis.

The first use of animal power in the performance of heavy tasks may have resulted from play. If a gentle beast were taken on a journey, some boy may well have entertained the idea of making it help carry the duffle. Shifting a pack to the back of a colt and strapping it there for the trip would be well within the range of resourcefulness. Or while drawing a heavy load he may have conceived the idea of employing the strength of the ox to pull for him, and may have fashioned around the beast's neck the first girdle that later was perfected in the yoke. The yoke was another epoch-making invention. It introduced the use of animal power in agriculture.

Following these great advances herdsmen and farmers took over the task of supplying the world with food.

The fundamental arts of living were all begun while as yet man lived on what nature provided, unaided by cultural practices. Long before the days of written records he began making fires and using tools and weapons. He sought out the best things that nature offered for his use and sustenance, and began making these natural products over into articles better suited to his needs. He traveled in a small way, making trails over land, and going by water in dug-out canoes. Doubtless he journeyed for adventure, for sight-seeing, and for the exchange of the products of his handicraft. We know about these things because archaeologists are able to interpret the fossil records and because ethnologists have studied the doings of backward peoples, some of whom still live in primeval ways.

The three main lines of all business were thus initiated before the days of agriculture.

1. Woodcraft: the getting of the materials of livelihood from mother earth, by hunting and fishing and general collecting (from which later developed agriculture, fisheries, mining, etc.); in a single word, *Production.*

2. Handicraft: the making over of these materials into more usable form; out of such practices all of our arts and crafts have developed; in a single word, *Manufacture.*

3. Barter: the exchange of these materials and products (introducing what we know as transportation and commerce); in a single word, *Trade.*

This period of fighting with wild beasts and against tribal enemies and of incessant foraging for a scanty livelihood was a time of rigid elimination of the weak and the incompetent, and of a general strengthening of racial stocks.

It would lead us too far afield were we to undertake even the briefest summary of the advances that have followed: the invention of the wheel and of hand tools in endless variety, and the making of machines; the utilization of the forces of nature, wind and water, steam and electricity; and on to such modern marvels as radio, aviation and television. But wonderful as these are, it would probably be a mistake to think that any one of them can have as great an influence on the course of civilization as the invention of writing or of the bow and arrow had in the past.

INVENTION

Man is the only tool-using animal, but the tools of his hand are guided by the tools of his mind. His greatest inventions are psychological, not physical. The first and

foremost and all-conditioning one was language. Words embody ideas and principles, which are the tools of the mind.

Let us set down in order side by side under parallel headings, A and B, a few of the outstanding material gains and correlated psychic advances of the four culture stages into which the history of civilization is sometimes arbitrarily divided.

I. THE HUNTER STAGE

A. Material gains:

1. Fire-making devices.
2. Tools for cutting (flakes of flint), piercing (bone awl), grinding (sandstone slabs), and hammering (stone axes).
3. Weapons: clubs, spears, bows and arrows.
4. Vessels of wood, of earth, shells, etc.
5. Clothing of skins, bark, and crude textiles.

B. Psychic advances:

1. Language, expressed in words, giving to ideas form and currency.
2. The use of fire.
3. Ideas of craftsmanship and trade.
4. Ideas of proper social behavior.
5. Ideas of cooperation in heavy tasks.

II. THE HUSBANDMAN STAGE

A. Material gains:

1. Fields for the increase of crops.
2. Herds as sources of materials for food, clothing, and manufacture.

3. Draft animals and beasts of burden.
4. Plow and cart: complemental inventions, the one to increase, the other to transport the products of the field.

B. Psychic advances:
1. Writing.
2. Private ownership of property.
3. The use of animal power, and of wind- and water-power.
4. Ideas of control of natural productivity for increase of crops and flocks.
5. Ideas of precision in computation: the Arabic numeral system.
6. Ideas of social organization: patriarchal, theocratic, etc.

III. THE ARTISAN STAGE

A. Material gains:
1. The printing press and books.
2. Money.
3. Hand tools, and new products and contrivances without number.

B. Psychic advances:
1. Ideas of diffusing knowledge by means of the printed page.
2. Schools as a means of intellectual nurture.
3. Ideas of a standard of values and medium of exchange.
4. Ideas of social control, of classes, of rulers, of empire.

IV. THE INVENTOR STAGE
- A. Material gains:
  1. Tools and machines for the tillage and the harvest of the fields.
  2. Machines for sewing and spinning and weaving.
  3. Machines for sorting and packaging.
  4. Typewriters and record filing devices.
  5. Tools and machines for the making of other machines, *ad infinitum.*
- B. Psychic advances:
  1. Ideas of the use of the forces of nature for conserving manpower.
  2. Taxation for support of public enterprises.
  3. Ideas of encouraging invention as a source of further progress (witness the patent office).
  4. Ideas of encouraging research as a source of invention (witness the research foundations).

All these gains brought increased wealth, and gave leisure and opportunity for some to devote themselves to the promotion of further knowledge;[2] for others, to the development of the vanities of civilization. Relief from the never-ending search for food was necessary before time and thought could be devoted to improvement in the ways of living. Leisure makes opportunity for taking thought.

[2] "Cloth would be woven on hand looms today had no other factor been introduced into spinning than the instruction of daughters by their mothers. The spinning jenny was not invented by a spinner. The wireless telegraph was not invented by a telegraph operator, nor was the science of agronomy developed by a practical farmer."—Stuart L. Gager in *Science*, 49: 295, 1917.

However selfishly the comforts and satisfactions of life may be acquired by individuals or parties, society has a way of appropriating the results unto itself, and making them more widely available. There were scanty comforts in life for the many until men had seen the opulence of a few; there were few decent homes until men had seen palaces; there was no harnessing of the great forces of nature until men had seen the great works done by the driven labor of slaves. The successes of the pioneers set a pattern for imitation that in time came to be used for the benefit of all.

Our species was very slow at adding nurture by means of its own devising. Competent students of pre-history agree that man has been on the earth for more than half a million years, perhaps for very much longer. With numbers so large the mind has difficulty. Professor Tozzer has made a statement of progress in terms of fifty years, that is much more readily grasped.[8]

In terms of 50 years it took

49 years to develop agriculture and the domestication of animals.

49 years and 6 months to develop writing.

49 years and 9 months to develop literature and the arts.

49 years and 10 months for the advent of Christianity.

Two weeks ago printing was developed; one week ago, the steam engine; and so re-

[8] This illustration is borrowed from a lecture that was given by Professor Tozzer at Pomona College in 1923.

cently, that upon this scale there has hardly been time for the ticking of a clock, radio flashed in.

Perhaps the most significant features of this time scale are the slowness of the start and the speeding up in our own time. The acceleration is due to the discovery that invention and research are worthy of public support and encouragement.

SOCIAL VS. BIOLOGICAL INHERITANCE

The gains of the past that make up our *social inheritance* are something superadded to our *biological inheritance* (our nature), differing from it in three important ways:

1. In biological inheritance the personal gains of the individual (knowledge, skill, etc.) are not transmitted from generation to generation, but each individual starts at the common level of his kind, and all the gains derivable from his environment he must for himself reacquire. In social inheritance each generation may appropriate the gains of its predecessors.

2. In biological inheritance there is chance combination of characters that are separately heritable in the germ cells of the parents, and the results are not predictable. In social inheritance the results are predictable; we know in advance that a child reared in England will speak the English language, and that one reared in Germany will speak the German language, etc.

3. In biological inheritance methods are fixed beyond our power of alteration. In social inheritance methods

change. We have an ancient adage to the effect that "The poet is born and not made," but the fact is that he has to be made after he is born; for he is born with nothing but the potentiality to become a poet, given the kind of environment and training that will bring that gift to perfection.

Social progress originates in individual initiative. Someone with a mind alert to try the untried finds a better way of doing a thing, a way not provided for in instinctive behavior. If the new way works well, it is adopted by others through intelligent imitation. But new ways always have to prove themselves. The old ways have the support of tradition and habit. Such is their fixity that all changes at first meet opposition. The first man to use a stone ax was probably ridiculed for it; he may have had to prove its effectiveness by using it on a tormentor's head. The steamboat was for a time called "Fulton's folly" and when Langley was experimenting with his aeroplane he was thought crazy to believe that men could ever fly.

"Man started at a cultural zero and had to find out everything for himself; or rather a very small number of peculiarly restless and adventurous spirits did the work. The great mass of humanity has never had anything to do with the increase of intelligence except to act as its medium of transfusion and perpetuation. We humans accept our breakfasts, our trains and telephones and orchestras and movies, our national Constitution, our moral code and standard of manners, with the simplicity and innocence of a pet rabbit."[4]

[4] James H. Robinson, in *Mind in the Making*.

The source of this progress is in the inventive mind[5] that can take a hint from nature, and use her methods and by them turn her operations to greater profit. It lies in the deftness of hand and alertness of mind of the few, and in the imitativeness of all the others. Most of us are like the dog at the fireplace; "it does not occur to us" to do anything about firing up. Earth's magnetism was at hand before the Chinese invented the mariner's compass and started the exploration of the great seas with its aid. Radio was long coming, although ether waves have always been available.

Many current ills are illogically charged to our improved machinery, but the trouble is not in the machines; they do their work well and are not amenable to arguments. Machines have taken the heaviest burdens from the back of the laborer. They have cheapened and multiplied the conveniences of his home. They have raised the quality, both artistic and practical, of a thousand useful products to a new standard of excellence. They have brought comforts that were unattainable before, and they have created better standards of living. It would be about as sensible to complain of knives because they are sharp, or of pens because they write well.

[5] Back of the motor's humming,
  Back of the belts that sing,
Back of the hammer's drumming,
  Back of the cranes that swing,
There is the eye which scans them
  Watching through stress and strain,
There is the Mind which plans them—
  Back of the brawn, the Brain.

—Berton Braley

Man rises above the animal level as he learns the ways of nature and adapts himself to them. He does not and cannot change them; he can only use them as he follows them, adapting his plans to her fixed conditions. His "conquests" of nature are all in fact but conquests of his own ignorance. Even so they are none the less admirable. They are contributions to that great body of social nurture that takes man as nature leaves him, a barbarian, and makes of him a citizen.

Chapter XIII

THE COMPONENTS OF SOCIAL BEHAVIOR

Society is an aggregate of persons, and what society does results from the activities of its constituent persons.

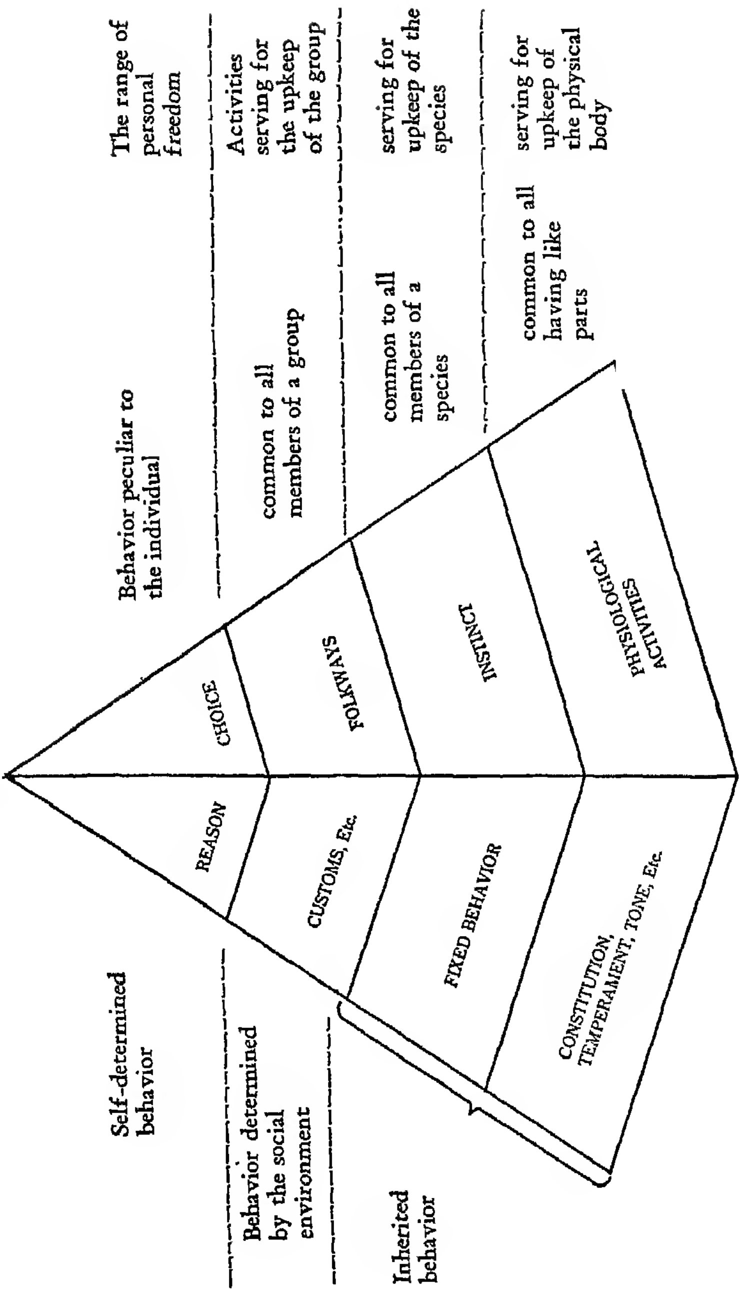
Broadly sketched, the components of social behavior are four. The four may be graphically presented to the mind as a pyramid in four sections. The broad basal section represents physiological activities. It underlies and supports and conditions the three above it. The next section above it represents instincts; the next above that, folkways, in the most comprehensive sense of that elastic term; and the small top section, which alone represents the freedom of the individual, may for our purposes here be labelled choice or reason.

The physiological activities have to do with the upkeep of the physical body. They are inherited. They are automatic in operation. They are common to all having like parts.

Instincts have mainly to do with the upkeep of the species. They also are inherited and automatic in operation. They are common to all members of a species.

Folkways have to do with the upkeep of the social order. They are acquired by the individual in his own

THE COMPONENTS OF SOCIAL BEHAVIOR



time, and they are determined by the social environment. They are common to all members of a tribe or other group of people that has long lived apart under relatively uniform conditions.

The exercise of choice and reason or other form of personal initiative is peculiar to the individual; indeed, the free exercise of this personal prerogative marks one as a very "peculiar" person.

Our figure of a pyramid in four sections is obviously arbitrary and artificial; nevertheless it represents certain aspects of the truth. Read from the bottom upward, it represents the order of development of social behavior, both racial and individual. Also each section conditions and limits the one above it. Also the diminishing size of the sections as we ascend corresponds in a measure to their diminishing power of dominance. Man behaves in a small part as he will, in a large part as he must.

Let us now proceed briefly to consider these four components severally.

PHYSIOLOGICAL ACTIVITIES

Basic to all else are physiological activities. These keep life going. These nature takes care of for us. She has put first things foremost and has made the work of bodily upkeep largely independent of volitional control. Our parts that are concerned with visceral processes (metabolism) do their work automatically and in health perfectly, and mainly without our knowledge. That we have a stomach we should learn from books and not from experience. Happily the digestion of our dinner does not depend upon our taking thought.

These physiological activities are common to all having like parts. Digestion may be studied in any animal that has a stomach, respiration in any that has a lung. The fundamentals are alike; only details differ. What we today know about the functioning of our own bodies has been learned largely from the study of the lower animals—not a little of it, indeed, from the lowly frog.

Food is the first and most insistent and ever recurring of all our needs. We cannot miss a meal without altering our behavior. There is no reasoning with a hungry man; he first must be fed. Social unrest first reaches its dangerous phase when stirred by pangs of hunger. Napoleon said that "An army travels on its belly"; so does all the living world.

Men differ in social behavior according to temperament; and temperament is influenced, if not determined, by the functioning of the organs of the body. We know that internal secretions are of great importance. For example, inadequate secretion of the thyroid gland tends to produce apathy, and in extreme lack, idiocy, while excess of it tends to produce undue excitability. We have long known that the sex glands are necessary for the development of secondary sexual characters. This knowledge is almost as old as the art of animal husbandry, wherein the herder removes the sex glands of the excess males of his flock in order to change their temperament—to make them more quiet, more manageable. After castration of the male calf, the horns and the huge neck muscles of the bull do not develop to the normal size, nor do his fighting propensities. He has become less active,

and will put on fat more quickly. He is changed and better suited to the husbandman's purposes.

Diseases also affect temperament, and in very diverse ways. Tuberculosis has been called the cheerful disease. The sufferer from it is generally optimistic. He is going to be better next week or next month. In contrast, the sufferer from diabetes is more likely to be filled with gloom if not with despair. Indigestion nurtures a cantankerous spirit. It is probably impossible for a person with a toothache to be an optimist.

Tone of muscle and nerve affects temperature. As our stomachs demand food and our lungs, fresh air, so our muscles demand exercise. Perfect functioning of all parts of the body favors mental activity and a cheerful outlook on life, while their bad functioning tends to dullness and introspection.

A "good constitution" is merely health and normality. If the words be figurative, the figure is not inappropriate; for the cells of the body do truly cooperate on a mutual plan. They began as one cell—the fertilized egg—and increased by cell division. They differentiated and mutually arranged and assembled themselves to form the necessary organs. It is as if they agreed that *in order to form a more perfect union*, an organism; to *establish justice*, equity in the distribution and use of the good of the body, each cell contributing according to its ability and each receiving according to its needs; *to insure domestic tranquillity*, "that [to quote St. Paul] there be no schism in the body," no uncontrolled conflict of parts; *to provide for the common defence*, as against the dangers and the

rigors of environment; *to promote the general welfare,* that is organic health; *and to secure the blessings of liberty to ourselves and our posterity do ordain and establish this constitution,*[1] literally this plan for standing together.

Ours is an animal body, and on its maintenance in health all our possibilities of happiness and usefulness depend. The fundamental driving power in human life and in society is here.

INSTINCTS

Instincts are the springs of conduct in men and animals. Those that have to do with the *preservation of the individual* are manifest in the activities connected (1) with hunger and the getting of a living; and (2) with fear and avoidance of enemies: with keeping alive. It is an old, old adage that self-preservation is the first law of nature.

Instincts that have to do with the *preservation of the species* are mainly (1) those that are manifest in love of mates, (2) those that are manifest in love of offspring, and (3) those that are manifest in love of kind. The first two of these, the conjugal and parental instincts, we of the human species fully share with animals generally; the third, the tribal instincts, we share only with social animals. These instincts are not selfish, as are those mentioned in the first paragraph; these lead instead to self-sacrifice in the defense and sustenance of others. The beginning of altruism is here.

[1] It will be obvious that italicized phrases are taken from the preamble to the Constitution of the United States of America.

As physiological activities serve to maintain concord between the body and its members, so instincts maintain proper relations between the body and its environment. Our basic urges are physiological. Nature has put first things foremost: has made sure that the activities of the organs that keep life going shall be independent of volitional control, and has added these other native urges that we call instincts to insure the survival of the individual and of the race. It is only in regard to the means that shall be employed for fulfillment of these native urges that there is need for taking thought.

We must eat to live. Until hunger is appeased the mind is not at rest. A certain measure of physical comfort is prerequisite to all normal social activities. We must be alert to dangers in order to keep on living. Our forefathers had a saying, "Eternal vigilance is the price of safety." So it is with the whole animal world. Although the devices of invention and the protection of society permit us nowadays to live in comparative safety, subconscious fears, inherited out of a lowly past, are ever with us. Who has not felt the fear of the dark, when darkness held only imagined dangers? Who has not recoiled instantly from the sight of a snake in the grass when coming upon one unexpectedly? It mattered not at all that the snake was pretty and graceful and quite harmless. The mechanism for snake avoidance is in our nervous system, organized and ready for instant service. Poisonous snakes have been enemies, dangerous to our race throughout most of its history. They are still very dangerous in India, where thousands die from snake bites every year.

We share with monkeys this innate fear of snakes. Good old Doctor Burt G. Wilder once kept a pet monkey on the campus at Cornell University, where it was of great interest to students. They shared their peanuts with it. They occasionally gave it a few peanuts in a bag in order to watch it open and empty the bag. One day a student handed it a bag with a very small garter snake enclosed in it. The monkey untwisted the top and peered into the opening. Instantly on seeing the snake it dropped the bag and sprang to the farthest corner of the cage and hung there trembling. That monkey could never be induced to open a bag of peanuts again.

So deeply ingrained is this fear of snakes in the mind of our species that it extends to other animals of snake-like form and mode of locomotion. Every biological laboratory has known students who shuddered at the sight of an earthworm—a soft unarmed creature a few inches long, weighing perhaps a fraction of an ounce, and with no capacity to bite or to sting. Think of it! A big vertebrate animal weighing more than 100 pounds, equipped by nature with stout muscles supported on a skeleton of bones and equipped by invention with steel tools! A moment's reflection shows that there is not a vestige of intelligence in such fear. It is merely the old dominating avoidance reaction, life-saving in nature, and needed in the past, but persisting far beyond the days of its usefulness.[2]

Instinct runs in well-worn paths of past racial experience. In the nervous system the right of way is given to

[2] A student once said to me, "The sudden sight of a snake does something awful to me inside."

those impulses that in past generations have led to proper actions, and therefore to success in the struggle for existence.

We have already discussed the instincts of animals briefly in Chapter VII. There are higher ranges of instincts in man directing the activities of his mind; and they are of very great social importance. We will devote the next chapter to their consideration.

FOLKWAYS

Folkways are modes of human behavior that are superadded to instincts. They are not inherited, but are acquired by the individual in his own time. They are the current ways that all peoples have of getting along together understandingly.

The folkways are unconsciously acquired. "We are born into the folkways as into the atmosphere."[8] We merely do as others do, unaware that we are in training for life. Thus we learn how to sit, how to stand, how to walk, how to greet friends, how to wear our clothes, how to behave at a wedding or at a funeral or at a banquet, when to wear a hat and when to take it off, and all the other little details that constitute good manners.

Folkways originate by the method of trial and error. Action of some sort is required to meet a situation. Aimless acts in great variety are tried. Some of these efforts yield better results than others, yield greater pleasure in social intercourse, are better understood, and better liked. Such ways are repeated, and imitated, and the less effective ones are gradually eliminated.

[8] Wm. T. Sumner, in *Folkways*, his masterpiece.

The steps are clear:

One does a thing—finds a way.
Others do it so—by imitation.
All do it so—and "It is done so."

When it becomes incumbent upon all to do it so, then the mores[4] are established.

Folkways regulate social intercourse down to its smallest details. Such little words as "Thank you" and "If you please" often serve great purposes. "Dear Sir" at the head of a letter is not necessarily a term of affection, but absence of it from the accustomed place there may give offense, may even imply hostility.

The folkways are uniform in a group and obligatory on all members of the group. When fully established they are like the instincts of animals in their fixity. They rule us as with a rod of iron. They are backed by public opinion. They have the sanction of society. They build tradition, and whether good or bad, they are always "right" and "proper"; there is no getting back of them. Tradition is its own warrant. If one presumes to do otherwise than as tradition prescribes he is assuming superior airs that his group will hardly tolerate.

The folkways are enforced by prescriptions and taboos; society says "This do" and "That avoid," and penalizes disobedience with ostracism.

The folkways are ever in the making. Each new invention that brings numbers of people into common contacts starts a new contribution to the folkways. The

[4] *Mores*, a term for distinguishing well-established from incipient folkways that has no utility for us here, and will not be used further in this book.

stagecoach, the steamboat, the railway train, the aeroplane each in turn contributed to the sum total of public manners. It is incumbent on one who drives an automobile in traffic that he shall by signal notify the driver of the car behind him when he intends to alter his course. By extending his arm full length from the window he says "I'm turning left"; by raising it from the elbow he says "I'm turning right," and by dropping it downward he says "I'm going to stop." These practices at present rule by common consent. They are not in statute law. Folkways precede statutes. Folkways justify and support the government, and without that support all statutes are ineffective.

Every segregated group of people develops minor folkways of its own—every college campus, every populous neighborhood, every large household. Let me illustrate this with the case of Smithers, one that interested me very much. Smithers on entering Cornell University as a Freshman encountered a local tradition that he did not like; it required all freshmen, regardless of their style, to wear through the year a little gray cap of prescribed pattern. Smithers didn't like to be told what to wear, and he didn't like the cap, and he refused to wear it. He was warned by the upper classmen, but he still refused, and went back and forth openly across the quadrangle wearing his ordinary head gear. He was again warned, but he considered the threat a violation of his Constitutional Rights to life, liberty and the pursuit of happiness. He knew he could not be happy in that cap. But what is a Constitution among a lot of upper classmen when bent

on benevolent bullying? They seized him bodily and ducked him in Beebe Lake; and he left the University—for a time.

The folkways differ markedly in different tribes and nations. As all travellers know, they change at every border. All societies have social needs in common but each meets these needs in its own way. These ways differ somewhat in proportion to remoteness and exclusiveness. On the other side of the world from us, for example, is China, a great nation with which our western world has had no close contacts until comparatively recent times. Her civilization is very old, and her folkways cover the details of social intercourse more completely than do ours, but they differ vastly from ours, and are often quite the opposite. An American in China, behaving with the very best Western manners, often finds himself doing exactly the wrong thing. Whole books have been written to set forth these contrasts in social manners. Here we can cite only a few of them.

In China the men wear gowns and the women wear pants.
White is the mourning color—not black.
A woman sews by directing the point of the needle *away* from herself.
A carpenter saws a board by *pulling* his saw through it; his saw cuts on the *drawing* stroke.
A gentleman *puts on* his hat to show respect.
He reads his book from right to left side.
He pays a compliment to a lady—even a middle-aged lady—by asking her how old she is.
The buttons on his gown are on the *left* side of the overlap.
His dinner may begin with a dessert and end with a soup.

> The proper behavior of a bride at her own wedding is to look as sorrowful as possible, etc., etc.

I was not able to verify in China the statement often heard in America that when a Chinese student is puzzled he scratches his foot instead of his head. Even if true, who shall say which place of scratching yields the best results in cerebral activity?

Custom demands not that we think but that we conform. The life of society consists in making and in enforcing the folkways. "It is a process that is never ended, and never superseded" (Sumner).

Since the folkways cover all manner of social intercourse, they are of very unequal practical importance. How one shall deal with his neighbor is fundamentally important; whether one shall eat pie with his knife is not important, except as a sign of his personal nurture and social standing.

Unlike instincts, the folkways change from time to time. Even those that regulate instinctive activities and maintain the basic elements of the social order may slowly change. For example, a young man may no longer get himself a wife by hitting her over the head with a club and carrying her off bodily to his cave. That procedure had its advantages: it was effective; it was expeditious; it was economical; and it left no question as to who was the head of the house—but it has passed.

Penal practices change. We no longer burn witches, or beat lunatics to drive the devils out of them.

The folkways are always consistent with the knowl-

edge and ideas of their time. The late Ada E. Georgia once gave me a striking illustration of this. She recalled the last public hanging in Ithaca, of which she had been a witness. A gallows was set up for the occasion on the greensward of Dewitt Park, a square partly surrounded by Ithaca churches.

This was the occasion for the hanging. A man from the Inlet Valley, in the course of an argument with his wife, had hit her over the head with an ax and killed her. He had been tried by a jury of his peers, and had been sentenced to be hanged by the neck until he was dead, and the hour of his execution had been announced to the public. On the day appointed the people came as on a holiday to witness the event. They came from all the surrounding country, in carts and in wagons, on foot and on horseback. They came by families in gala attire, bringing their lunch baskets, swarming into and overflowing the little square about the gallows.

The local authorities welcomed them and prepared for their entertainment. A procession headed by a brass band conducted the victim from the jail to the gallows. On the way the band struck up a funeral march, whereupon the victim demanded that they stop it, and play something lively. Then they obligingly played *Yankee Doodle.* Reaching the park, the victim was led upon the scaffold, the black cap was drawn over his head, the noose of rope was adjusted about his neck, the trap was sprung, and his body dangled before the fascinated gaze of the multitude. An official pronounced him dead, and the people went home satisfied. Justice had been done, and in the way that

society then demanded; the idea being that publicity of punishment serves as a deterrent for crime by warning others against a like fate.

We no longer make a holiday out of seeing a man hanged. Yet public hanging is mild as compared with many bloody spectacles of the past, some of which involved the sacrifice of wholly innocent persons, and all of which at times had the full sanction of society.

Fashions are in the folkways. If on first thought their changeableness seems contradictory, on second thought we realize that they are made only to be changed, and that their rule is imperative and unchanging. They are the perfect instruments for the enhancement of personal prestige.

There are fashions in everything, speech, arts, science, education, as well as in clothes; but we oftenest think of them as pertaining to dress. Since all wear clothes, here is the easiest means of assuming the outward signs of up-to-dateness. In this case the fixity is in the human behavior, not in the cut of the coat. The word that is used most effectively in advertising new styles in clothes extols not their beauty nor their serviceableness, but their *smartness;* it is the most appropriate word.

The conditions for this irrational behavior are provided in our restless brain that is forever seeking novelty within very narrow limits and in our innate desire for enhanced personal prestige.

Do animals have folkways? The answer is No; and yet a few animals may be trained in our own folkways. Dogs and cats may be "housebroken," for example, and

a dog on a ranch may be trained to guard the sheep instead of killing them. Chimpanzees and orangs may be taught more of our ways than any other animals. All who have kept these apes as pets agree that they are just like children in their ways. They are affectionate toward their keepers and shy of strangers. They behave as directed while under supervision, but revert to animal behavior at every opportunity, casting off as a garment the human folkways that have been imposed upon them. They may be taught table manners—the use of knife, fork, spoon, and napkin at the dining room table—but they revert at once to gobbling food when they think themselves unobserved. They are generally playful, and friendly in their play; but they are also subject to sudden fits of violent anger. Trader Horn says of them:

"If any philosopher were to give it thought he'd see that there's nothing brings us closer akin to the apes than the tantrums we get into."

In her charming little book "Four-handed Folk," Olive Thorne Miller introduces a picture of a comparatively well trained orang on a rampage. He is swinging by one hand on a chandelier above a dining room table while pulling the table cloth and scattering the dishes with his feet. She labels the picture "A Relapse into Monkeyism." The orang is not the only high primate that is subject to such relapses.

The well trained person, ape or human, is the one who has the folkways well learned. Animals are taught these ways, not by examples set for them to imitate, but by a judicious application of rewards and punishments.

A neighbor of mine bought a trained show-horse from an abandoned circus and set him to work on a farm. When the horse was plodding along in the furrow, plowing the field, he moved with a very dispirited air, head and tail drooping and with lagging steps, but when driven to town he began to step up briskly as soon as he was among people again. With head up and neck arched and ears pointing forward, he acted as if he expected to be noticed.

Animals have no clothes, but many of them take evident pleasure in preening and in keeping their natural vestiture in presentable (or is it only comfortable?) condition, and a few make artificial improvements in it. There is the bird called the mot-mot, for example, a bird of the American tropics, about the size of a pigeon, with orange breast and blue-green wings and crown and a drooping tail. It has the habit of stripping the web from each side of two extra long lateral tail feathers, one on each side, leaving the shaft bare for a distance, with a tuft at the end of the feather. Dr. P. P. Calvert, who has observed this bird in Costa Rica, says:

"The effect of these mutilated feathers as the bird, sitting otherwise motionless, moves its tail from side to side, is very curious and somewhat resembles the pendulum of a clock."[5] Do we say "With a mind for such improvements, what might not such a bird do with gowns?" No, for this improvement in tail feathers is made by all mot-mots to the same two feathers in practically the same way. The habit is fixed and unchanging. It is in the instincts of the species.

[5] *A Year of Costa Rican Natural History*, p. 341.

The folkways are human behavior. They are due to the exercise of powers of imitation that animals possess in a very small measure indeed. What we here have in common with animals is merely the method by which folkways originate, the method of trial and error.

Thus far we have used customs alone for illustrating the subject. There are other products of the folkways that are of very great social importance, and to their consideration we shall return in Chapter XV.

REASON

The small top section of our Pyramid of Components represents personal freedom: freedom of choice and the right to exercise judgment. This is based on and strictly limited by the sections below it: folkways, instincts and physiological activities. Consider these limitations:

1. We can do nothing to change physiological processes. Nature has taken full charge of them. We can only look to the maintenance of hygienic conditions for their operation: cleanliness, proper food, regular exercise, adequate sleep, and temperance in all things.

2. We can do nothing to change our instincts. They are a part of our nature. They cannot be suppressed, but they may be guided, and their vast emotional power may be kept to proper channels in its exercise.

3. We cannot evade the folkways; in the main we must conform to them. To do otherwise is to be ineffective, for we can do little in isolation.

The range of personal freedom thus limited is very narrow; but it is all important, for out of it come all social

progress, and all that is distinctly human in the doings of mankind. These products of the higher faculties of choice and of judgment are aspects of society that are not zoological, and they, therefore, fall outside the scope of this book.

Chapter XIV

THE ROLE OF INSTINCT IN HUMAN AFFAIRS

In Chapter VII we have already noted the chief characteristics of instinctive behavior: its spontaneity; its fitness to normal conditions; its fixity and inadaptability to changed conditions; the necessary sequences in its performance; its changes accompanying bodily changes during development; and the evidences that instinct has developed along with the evolution of the body. Also, in Chapter XIII we considered the relation that instinct bears to physiological activities on the one hand, and to folkways on the other. We there set down the names of a few of the instincts that have to do with meeting the physical needs of the species. Let us now amplify that classification a little, and then give more particular heed to the instincts that serve the needs of the mind, and that condition the development of the social order.

A Classification of Instincts

I. Instincts serving physical needs.
   - A. Serving for the preservation of the individual.
     - a. Hunger: food seeking, and other activities of getting a living.
     - b. Fear: escaping enemies, and other means of keeping alive.

B. Serving for the preservation of the race.
  a. Conjugal instincts, manifest in love of mates.
  b. Parental instincts, manifest in love of offspring.
  c. Tribal instincts, manifest in love of kind.

II. Instincts serving psychic needs. Innate urges, common to all of our species. Broadly stated, they may be grouped in two general categories.
  A. Constructive urges.
  B. Possessive urges.

The instincts that serve physical needs we share with animals, but the tribal instincts, only with social animals. When moved by hunger we seek food. When threatened with danger we look for protection or for means of escape. We do these things instantly, automatically and without forethought.

The conjugal instincts have had a long history,[1] with halting progress and slow gains, as we have seen in Chapter IX. That they are deeply ingrained in the nature of our species is evident on every hand. We say that our nation is founded on homes, and clearly our homes are built on the mating instinct, and result from its dominating and automatic control. Homes follow upon marriages, and marriages are preceded by the blessed affliction known as "falling in love." Who that has seen two innocent young people overcome by this "divine malady," and has followed their case record thoughtfully and objectively, ever considered it a reasoned performance, proceeding step by

[1] A very matter-of-fact and self-contained young woman in one of my classes in zoology once dropped a remark that led me to say to her, "There is a streak of the romantic in you after all," whereupon a man student standing by dryly remarked, "It is a property of protoplasm."

step on a basis of logic? That is not saying there is no need of the application of reason in particular cases; it is only saying that the actuating cause lies further back. It is deeply rooted in the physical organization of our species. Nature has thus insured the continuance of our species upon the earth.[2]

The parental instincts are less ancient than the conjugal, and have made slower progress in permanence, especially on the part of the male sex. In most animals that give any care to their young this care is exercised only by the female. In a few, the male also is protector and a provider for the family. Our species has the honor to be numbered among these few.

It is the testimony of social workers that when appeals to reason, to loyalty, to patriotism, and to friendship fail, mutinous men may still be brought to do right if shown that their doings endanger the security of their homes. They will not deliberately do the things that cause their little ones to lack for food and shelter. The effective appeal is to the instincts that are most deeply rooted in their better nature. The fountainhead of social progress is the family.

The normal and proper exercise of the primal altruistic racial instincts is the chief basis of human happiness. The consuming joy that lovers find in each other's company, the captivation of a baby's smile—of one's own

[2] "Our appetites of one and another kind are excellent spurs to our reason, which might otherwise but feebly set about the great ends of preserving and continuing the species. They are fit blessings to be contemplated at a distance with a becoming gratitude." Charles Lamb in *Essays of Elia*, "Grace Before Meat."

baby's smile, the sense of belonging within the family circle: these are far older than church or state or any other artificial products of the social order. They are the products of a natural evolution. They are the greatest of God's good gifts to humankind.

Tribal instincts belong to man and a few of the social animals. They have grown out of parental care, extended first to kin and then to kind. They are manifest in gathering together for pleasure, for defense, and for mutual aid.

I have seen the roadsides in England cluttered with advertising signs stating "Dogs are happy when fed on ————'s Dog Food"—a statement quite unfair to the dogs; for dogs like company and excitement, a chance to run with their fellows, and to fight. Their social nature is not nourished by meat alone.

To the more socially inclined, solitude brings misery. When the great psalmist, David, wished to tell of his woe he wrote, "I am a sparrow *alone* upon an house top" (Psalm 102: 7). Apes and some monkeys do not live long when kept from others. Horses suffer from restlessness if stalled alone, and seem to feel better if given even a dog for company. And so it is with men: within prison walls, the ultimate in severity, short of death penalty, is solitary confinement.

INSTINCTS SERVING PSYCHIC NEEDS

It was formerly thought that man had fewer instincts than animals, and differed from them in being ruled by reason. That was fond illusion. Psychologists began studying the automatic behavior of our species and soon

came to the conclusion that man has more instincts than do animals. This was a swing to the opposite extreme of opinion. The fact appears to be that man has the same classes of instincts as have nearly related animals, but with a larger capacity for volitional control. Instincts are the springs of conduct in man as in animals. The innate urges are the same, but the higher faculties of man may modify and enormously complicate the acts that spring from them.

The efforts of the psychologists to define and delimit human instincts—particularly those that serve the needs of the mind—have not been very successful. I have endeavored to follow their systems, only to become lost in the wilderness of their definitions and abstractions. For present purposes it will not be necessary to go beyond a modest effort to reduce the higher forms of inherited behavior to a few simple categories.

I propose to discuss them under the two groups of urges named on page 185, *constructive* and *possessive* urges, and their opposites, and to further elaborate these only to the extent of showing those main social gains to which they have given rise, as indicated in the following table.

Special Instinctive Trends

1st Pair: *constructive urges or the opposite.*
(Example: curiosity *vs.* fear, *i.e.,* fear to venture.)

	Controlling urges	*Developing or retarding*
Do or Don't impulse	to know	Science
	to feel and interpret . .	Art
	to work	Crafts
	to play	Sports

2nd Pair: *possessive urges, or the opposite.*
(Example: benevolence *vs.* acquisitiveness.)

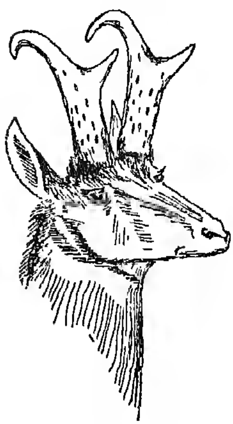
	Having to do with	*Bestowing or requiring*
Give or Get impulse	goods	Property
	obedience	Power
	approbation	Prestige
	help	Service

That we are dealing with innate urges common to all mankind needs no argument—needs only a little acquaintance with the world's diverse peoples. All have developed science, art, crafts and sports. In all there is striving for property, power, prestige and service.

Science, art, and crafts are of course peculiar to human society; but the basic urges back of them are not entirely absent from the animal mind. Let us note some things in evidence.

Animals have curiosity, the "divine instinct," the desire to know about things, which is the ultimate source of all science. Many of the antelope that once swarmed

over the plains eastward of the Rocky Mountains were killed by hunters who took advantage of their curiosity to get near them. A hunter would lie down in the grass out of sight, and would wave above the level of the herbage some object of unusual appearance—a flag, a tin pan, or even his own feet. The antelope seeing this would cautiously approach for a nearer view of it. When they came within range of the gun, the hunter would rise up and shoot.



The prong-horn antelope.

Monkeys are full of insatiable curiosity, as everyone knows who has had a monkey for a pet. Even cats show it unmistakably.

Even if animals have no art, I believe that many of them have something of a feeling of appreciation for scenes of beauty. I have seen it in the lovely landscape sites selected by many birds for their nests, and in the lingering of horses and cattle on the finest viewpoints in their pastures and their steadfast gaze at far horizons.

A dog that for years accompanied two of us on our morning walk to my laboratory showed a liking for one particular view on the way. The viewpoint was on a side hill path through heavy woods. The view was of a stream at the foot of the slope. A natural canopy of boughs of beech and hemlock overarched a charming vista of foaming waters in a rapids at the head of a waterfall. The dog, though generally at our heels, would always run ahead and stop at the point in the path where this particular view

was best. He would stand there looking at it steadily until we caught up with him, and then fall in behind us again. This was a daily occurrence through years when we were together. There was no knowing what went on inside that canine cranium, but I could not but feel there was some aesthetic sense there.

And as to work: that animals work sometimes for the sheer joy of working there can be scarcely a doubt. Marsh wrens are furious workers. They often build half a dozen nests among the sedges in rapid succession, and then can use but one of them. The others, apparently equally well constructed, stand unoccupied.

Dr. Elsa G. Allen says that the chipmunk "has an overwhelming instinct to dig its burrow . . . and consequently spends far more time and energy on its construction than are necessary either for the upkeep of its home or as a maze for [confusion of] its enemies."

Anyone who has seen a dog in the act of digging a woodchuck out of his burrow will have noted his enthusiasm for the task. Indeed, among the figures of speech that are current among farm laborers there runs a familiar simile, "working like a dog at a root."

The urge to play is most obvious. Everyone has seen animals at play and has noted their obvious enjoyment of it. Lack of playfulness in young animals is a sign of bad health or of defective inheritance, as it is also in children.

When we come to the possessive group, the give or get urges, aside from parental nurture there seems to be less trend toward giving on the part of animals than in man. The joy of getting is much more evident in both.

Goods are stored for future use by many animals.

Squirrels store nuts and acorns, and bees store honey.[3] There is much that is almost human in the acquisitive ways of some animals.

Many a bird goes around the neighborhood selecting the materials for her nest with the preciseness of a careful shopper at a bargain counter. Property is stolen by one animal from another with the same freedom from guile with which we humans rob hens of their eggs, bees of their honey, and calves of their mother's milk. Only a few of the primates appear to steal for the sake of stealing—or is it for the sake of amusement? A spider monkey in the San Francisco zoo is reported to have reached out through the bars of his cage and seized a bone that a dog was gnawing. He then leaped with it to a high perch inside, and sat there chattering. He could not use the bone himself; he seemed to be merely enjoying the dog's discomfiture and amusing himself at the dog's expense, even as a cat purrs while it tortures a half-dead mouse.

As to obedience and the power of control, there is a lamentable likeness here between human and animal behavior. Who shall rule? is a prime question in every group of men and animals alike. Who shall have the pleasure of getting his own way? The impulse to conflict is nearly universal, and brute force is the only way of settling the question among animals. It is too often the way also among men.

Prestige generally goes with the acquisition of power. But when mind comes into ascendancy among men, approval of the ways of the ruler is needed to secure willing

[3] "Go to the ant thou sluggard; consider her ways and be wise: Which having no guide, overseer, or ruler, provideth her meat in the summer, and gathered her food in the harvest."—The Bible, *Proverbs* 6: 6.

submission to his rule. If we cannot ourselves rule, such is our human mentality that we may be happy in supporting the rule of someone else, and thus modestly sharing in his eminence. Prestige is a very big word in human affairs.

Our actions are ever in a state of balance. Our doing and our giving are held in check by our urges to avoid and to withhold.

The vast difference between man and animals in the outcome of all the activities of the types above cited is mainly due to two things:

1. Man has a vastly wider range of cerebral activity, and ventures far beyond the stereotyped behavior of his ancestors in gaining new experiences.

2. Man alone has developed the means whereby these experiences may be communicated to others, and preserved, and organized into the creations of the mind that are our culture. Our minds are so constituted that we may find satisfaction either in doing or in shunning, in giving or in getting, accordingly as emotions move us or as circumstances compel.

In each of these two pairs of basic urges there is a good and an evil member. Two trend toward civilized living; the other two, fear, "the great inhibitor," and selfishness are the great sources of evil, so great that they comprehend in themselves about all the evil there is in the world of men. Our usefulness as members of society is determined by which of these two trends we allow to dominate our lives.

Civilization is the product of all our doing and our getting. Instincts permeate all its processes, and often dominate them.

Chapter XV

THE CHIEF PRODUCTS OF THE FOLKWAYS

In Chapter XIII we have already discussed the nature and origin of the folkways, their spontaneity, their fixity, their uniformity in a group, their diversity in different groups, their compulsion in social conduct, and their utility in furthering social cooperation and mutual understanding. Not enough has been said about their share in creating the vast difference that exists between human society and that of social animals.

We still eat flesh as do carnivorous mammals, but with a difference. We slay the beasts, and skin them, and cut them up and devour them; but we hide the rawness of the flesh by cooking; we serve it from a platter instead of pouncing upon it on the ground; we do not grab and gobble it, but we divide it daintily upon the table around which we gather. We have table manners; we start evenly and share alike. We eat from plates with knives and forks, and have table decorations of silver and lights and flowers to remove the last reminders of our primeval ways and lowly origin.

So it is with all the other necessitous duties that our animal nature imposes. These amenities of human living

are all in the folkways. They have grown by small accretions resulting from individual initiative. There has been some exercise of judgment in their selection. A thin crust of rationality now covers our instinctive behavior, keeping it in a measure to proper (approved) channels.

The three great products of the folkways are (1) *language*, (2) *money*, and (3) *customs*. Thus far we have used only customs to illustrate them. The others are of like nature, as we see at once when we go abroad. All are group ways, peculiar in each nation. All change at each international boundary. The change is greatest if that be also a racial boundary, separating groups that have long lived apart. All have grown without anyone's planning, and all keep on growing without let or hindrance. Each nationality has its own language, its own money, its own customs, fulfilling like group functions. The functions may be broadly stated as follows:

1. Language provides a means of accumulating knowledge.
2. Money provides a means of accumulating power.
3. Customs provide a means of social control.

LANGUAGE

The language of animals is sign language; or, if it be communication by sounds, the making of the sounds and of the responses to them is inherited, instinctive, and essentially alike in all members of each species, and peculiar to the species. The sounds are not words. By the method of trial and error a few animals (dogs and some of the higher primates) may be taught the meaning of some of the words we use, but they have none of their own.

One may hear a variety of sounds made by the members of a flock of domestic fowls. The cock has one tone in crowing defiance to a rival, another in telling the joy of living to his harem. He has a throaty cluck, cluck, cluck when he gallantly announces to them the discovery of a choice bit of food (though he may absent-mindedly swallow the tidbit himself). His cry of alarm is guttural when announcing the approach of a prowling cat or dog, and it is higher and more shrill when he sees a hawk in the sky.

The hen cackles when she lays an egg, and for the proper bringing up of her brood of chicks she has a variety of notes: one to entice them to come under her wings; another to call them to come and eat; another to warn them of danger; and still another to recall them from straying.

These are not words, learned by the chicken in her own time, but bits of inherited behavior, automatically performed. They grow out of biological, not individual, experience. They are, however, the means of communicating thoughts. Even in ourselves it is still true that "actions speak louder than words."

Man's vocal apparatus was equal to the making of a great variety of sounds, and his restless brain led him to using his tongue rather freely (animals use mainly their vocal cords). Thereupon followed the discovery of the usefulness of words as a means of conveying thought in greater variety and with far greater precision.

Language, the thing that so completely differentiates us from the animals, is a product of wholly natural proc-

esses. Its growth has been from the beginning as little planned or premeditated as the growth of the petals on a pansy or the ears on a pig.

Doubtless man's remote arboreal ancestors loved to hear themselves chatter; and their chatter meant different things according to the manner of its utterance. It could convey ideas of pleasure and of pain, of wrath and of alarm, of intent and of desire, with varying stress to indicate possible shades of meaning in these elemental feelings. Man made these utterances more precise and better suited to the needs of social converse. To special sounds he gave definite concepts; and these are the bricks in the house of knowledge. Words convey ideas, preserve ideas, promote ideas.[1]

Nothing more clearly belongs in the folkways than language. If we would be understood, we must use words as others understand them. If we would be respected for culture we must use words as other cultured people use them, in accordance with the rules of grammar.[2]

When we write we must spell words as the dictionary prescribes.[3]

[1] "A library is not merely a hall of books, but a hall of records of human experience and thought, where one may learn the path along which man has toiled, and may discover guiding and liberating influences for the future."—George R. Minot in *Science*, 88: 416, 1938.

[2] "Grammar makes kings obey its laws"—Molière.

[3] Thus preserving all the absurdities of spelling that the method of trial and error has wrought in the evolution of our English tongue. Some forty or fifty years ago the directors of the American National Educational Association fell to thinking of the vast amount of time now wasted by the pupils in our public schools in learning to spell hard words. They offered a list of ten common words and proposed that these words be spelled as pronounced, with the omission of silent and superfluous letters. This rational suggestion ran

Words are condensed and convenient symbols of experience. Without language one may profit by the doings of others only to the extent that he is an observer of those doings; but ideas when expressed in words are detachable, and may be told abroad. They do not perish with the individual. Language thus functions as an organ of memory for society.

The nature and function of words was well expressed by the British physiologist, Professor Starling, as follows:

"A word is a fairly simple motor act, and produces a correspondingly simple sensory impression. Every word, however, is a shorthand expression for a vast sum of experience and by using words as counters it becomes possible for the nervous system to deal with its own experience. Education now involves the learning of these counters and of their significance in sense experience: and the reactions of the highest animal, man, are for the most part carried out in response to words, and are governed by past education of the experience content involved in each word."

Our language carries along a load of outworn characters that, like our wisdom teeth and skin-twitching muscles, are vestiges out of the past: silent letters, obsolete words, altered meanings, etc. It has all the earmarks of a product of natural evolution. It has roots and branches, and proceeds from simple and small beginnings, with in-

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counter to the folkways and died at birth. One of the ten words was *though.* I agreed that t-h-o spells tho as well as does t-h-o-u-g-h, besides saving time and ink; and I adopted it at once. I have been writing t-h-o ever since in my manuscript; but my editors have religiously added u-g-h. I have allowed this, because it does not pay to quarrel with an editor. He has the support of tradition, if not of common sense, and most of the dictionaries are on his side.

crease and continual differentiation. Our dictionaries are forever growing and forever changing, with no more intent or planning or purpose in the changes than there was in the beginning.

MONEY

Money is peculiar to man. There is hardly anything in the behavior of animals that even remotely suggests the use of money. Indeed there are living peoples to whom money is quite meaningless. It is a modern thing; it hardly antedates recorded history.

That money is a product of the folkways is at once evident when we consider its unpremeditated origin, its relative fixity and the compulsion of its use, its uniformity within the national group, and its diversity in different groups. At every national border the money changes. Dollars are exchanged for pesos or bolivars or milreis in the Americas; for rupees or yens or ticals in Asia; for pounds or francs or marks or rubles, or a dozen other kinds of monetary units in Europe. Nobody planned it; it just grew, as naturally as a squirrel or a dandelion. It is quite unnecessary to repeat here the well known story of how money was preceded by barter, by direct exchange of goods;[4] was initiated by the selection of convenient objects (cowrie shells, wampum beads, porcelain discs, etc.) selected by common consent and agreed upon as having

[4] There is the familiar story of the Dyak man in Borneo who, lacking the money concept, went to a public market with a lump of beeswax that he wished to exchange for red ribbon, and spent the day wandering from stall to stall vainly trying to find some one with the desired ribbon who wanted beeswax.

definite exchange value; how these were followed successively by coins of precious metals, by paper money, and by various certificates of credit. It was nowhere planned or intended or anticipated. It was initiated by trial and error and adopted by imitation, and it required general acceptance before it could become the standard of value.

Money is, after language, the most marvelous product of the folkways. Besides being a medium of exchange and a standard of value, it is a repository of power. Money sustains the enterprises of peace. Money supplies the sinews of war. Money is itself the weapon with which men fight in economic strife. It is wonderful in its flexibility and in its adaptability to any use. Like blood in the body, circulating through every tissue, bringing the materials for cell growth and carrying away the products of cell activity, good and bad products indifferently, so money circulates in the body politic, bringing supplies and taking away the products of the labor of individuals.

Money is most wonderful in the way it can abet our instinctive urges, good or bad. It sustains with equal indifference the sword and the altar. What a good Samaritan with his bottles of wine and of oil can do for one sufferer, a well-endowed hospital can do for thousands, and one man may endow it. What a monkey can hold in his arms, and thus keep others from using, is very little; but what a man may gather and store and hold by the use of the power of money is amazing indeed!

CUSTOMS

Customs are ways of social intercourse, tested by experience and required of all members of a group. They

have already been briefly discussed in Chapter XIII, where we have seen how they enable the members of a group to work together understandingly. They originate in each group spontaneously, and to them all members of the group must conform. All societies have them, for all have the same social needs: but each meets these needs in its own way. Each compels conformity to its own—by stares and sneers in matters of lesser moment, by statutes and penalties in matters of greater importance.

Since customs arise by the method of trial and error—a method that often develops ways of going elaborately wrong along with ways of giving right—they often stand in need of alteration; but reason is well nigh impotent to effect change in the ways that lead to the fulfillment of basic instinctive urges.

Nothing is easier than the discovery of wastefulness, irrationality and error in the customs of strange peoples, or more difficult than rectifying the errors in our own folkways. For example, the customs of child marriage in India and the burning of widows on the funeral pyres of their husbands we instantly condemn as irrational, but we condone or commend our own cult of false patriotism that nurtures militant nationalism, and leads to wholesale human slaughter and to wounds without cause.

These three great creations of the ever restless human mind, language, money and customs, have made human society. Each is a marvelous phenomenon, each a growth from the slenderest of beginnings, proceeding by small added increments of individual initiative. In the end,

how small is the individual in comparison with the vastness of the result!

All are products of the human mind, yet each surpasses the compass of anyone's mind. One can master only a small part of the words that tell of human experiences; a great and ever-growing dictionary is required to hold them all. Money is a product of human labor, but what can the labor of one's own hands do in comparison with what may be wrought by accumulated wealth? And what effect can one person's actions have as compared with the weight of public opinion?

In considering these marvelous creations of human society, if we seem to have wandered far from the field of zoology, we need only to remind ourselves that the little increments of progress out of which the great things have grown all go back for their source to native urges that are common to all mankind, to urges that have their foreshadowings in the instincts of some of the social animals. Happily these urges still operate. The end is not yet; the restless mind of man still ventures, still achieves.

Now, having examined the components of social behavior separately, let us in the remaining chapters try to see how they work together in a few of the major activities of human society.

Chapter XVI

WAR IN ITS BIOLOGICAL ASPECTS

Of all the great enterprises in which society at large engages, the greatest are war, government, and religion. Let us now consider each of these in its biological aspects, beginning with war.

War is due to inherited animal instincts, badly controlled by evil folkways, and lacking intelligent guidance.

INSTINCT OPERATES

Ours is a fighting species. In the animal world fighting species are comparatively few. Very few animals are prone to giving offense. They may crowd and trample and rush one another for food or for mates, but they do not fight for the sake of fighting. Only the fighting species go out of their way to do that. They are the animals with which we are most familiar, mainly the social ones; and they have certain common characteristics in which *Homo sapiens* fully shares. Let us briefly note some of these characteristics: first, some physical characteristics.

1. In the fighting species the males are larger than the females. In others, the females are generally larger. Nature has imposed the burden of reproduction more heavily upon the female and has endowed her with greater

strength to bear it. But fighting falls principally to the share of the males, and in the species that voluntarily fight, the males are larger. The difference between the sexes in size is greatest in the most combative animals, such as the horned cattle and spurred fowls: among the Primates it is greatest in the brawling quarrelsome baboons and in Man.

2. In the fighting species the males are better armed for combat. Think of the weapons they bear: the horns of the bull, the antlers of the stag, the tusks of the boar, the spurs of the cock, the long, razor-sharp canine teeth of male baboons, etc. If man was not similarly endowed by nature, being allowed nothing better than big fists, he was given a mind that readily turned to the invention of weapons; and his weapons became so effective that all the great beasts were placed completely at his mercy. The only really dangerous enemies remaining to him now are those he has artificially created—the ablest of his own species.

3. In the fighting species the males are more highly decorated than in the non-fighting ones. Think of the comb and plumes of the cock, the wattles of the turkey, the mane of the stallion, the garish seatpads of the male baboon—and then think of the beard of a man! Whiskers may be an endowment of doubtful value, not highly prized by all men, badly maltreated by some; but they are potentially present at least, and they serve to indicate man's place among the belligerent.

4. In the fighting species the males are more highly endowed vocally than are the females. Think of the sounds they make: the bellowing of the bull, the braying

of the jackass, the crowing of the cock, the gobble of the male turkey, the whistle of the stag. Always the fighting male has the loudest whoop; and in these days of clamor for complete equality between men and women, with all the claims of male superiority toppling, here is the place where the rampant he-man may make his last stand: he can always make more noise!

5. The fighting species have another common characteristic of far greater significance than any of the foregoing. It is only among these that the males are defenders of the females and the young. Elsewhere the males seek only their own safety. They leave the females and the young to shift for themselves.

Even as we share the physical, so we share the mental characteristics of the fighting species. We fight like animals. Shakespeare has expressed this for us very vividly in the stirring passage from *King Henry V* which begins:

> "Once more unto the breach, dear friends, once more,
> Or fill the wall up with our English dead"

and then presents this picture of effective fighting:

> "In peace there's nothing so becomes a man
> As modest stillness and humility:
> But when the blast of war blows in our ears,
> Then imitate the action of the tiger;
> Stiffen the sinews, summon up the blood;
> Disguise fair nature with hard-favoured rage;
> Then lend the eye a terrible aspect; . . .

> Set the teeth and stretch the nostril wide,
> Hold hard the breath, and bend up every spirit
> To his full height. On, on, you noblest English."

"'Noblest English!' Sweet commendation for sheer beastly ferocity!

We come by our fighting propensities naturally. The fighting spirit is born in us. Normal boys fight. It is a part of their growing up. They can hardly avoid fighting. By the use of their small fists they determine who shall be the leader in the neighborhood group. Just as with animals, when a stranger joins the group the question of dominance has to be taken up anew and settled all over again.[1]

Perhaps boys ought to fight—a little: enough to learn something of their limitations (their mothers may not concur in this opinion); but they should do it early in life, and get it out of their systems. Everyone has noticed that the fun of young animals consists largely in sham battles that are begun hilariously with a show of mock anger, and that sometimes have a wind-up of the real thing.

Games that demand strength, keenness, and agility are our best substitutes for brawls; and it is a sign of progress toward a civilized state of mind when an adverse decision or the loss of a game no longer engenders a fight.

[1] Eugene Field, the gentlest of poets, knew boys. He put both the native puerile urge and the parental effort toward its repression in these two lines from "Seein' Things."

> "One time when I'd licked a boy who'd just moved on our street,
> And father'd sent me off to bed without a bite to eat," etc.

All of our history and romantic literature seem to show that men also *love* fighting. Sir Walter Scott sang of

> "The stern Joy that warriors feel
> In foemen worthy of their steel."

War has been a great game, planned and prepared for as a game, and played for the highest stakes.

"To the French aristocracy of the old regime a battle-field afforded the most delightful and exciting of experiences, more delightful and exciting than the hunting parties in Fontainebleau. . . . Even the English, who took life much more seriously, were perfectly happy when it came to war. And so the world fought in and out of the centuries; and though it has become very much the habit to blame kings and ministers for these things, the truth is that the world fought very much because the world loved fighting."

In the national military cemetery at Vicksburg, Mississippi, on the roadside tablets among the graves of the soldiers of the war between the States one may read:[2]

> "The muffled drums' sad roll has beat
> The soldier's last tatoo;
> No more on life's parade shall meet
> The brave and fallen few.
> On Fame's eternal camping ground
> Their silent tents are spread,
> And glory guards with solemn round
> The bivouac of the dead.

[2] From Theodore O'Hara's *The Bivouac of the Dead:* written as a memorial to the soldiers of the earlier war with Mexico.

"The neighing troop, the flashing blade,
The bugle's stirring blast,
The charge, the dreadful cannonade,
The din and shout are past;
Nor war's wild note nor glory's peal
Shall thrill with fierce delight
Those breasts that never more may feel
The rapture of the fight."

The *rapture* of the fight: the biggest word in the English language for expressing keen delight!

Men and nations fight, as do animals, when well armed, well fed, well conditioned generally, and when there is nothing much worth while to fight for or about.

One cannot say that men fight on a higher plane because they have codes of honor: fighting animals also have unwritten codes. I was first convinced of this by watching the fight of two young cockerels that were reared together by one of my young sons. The two birds were of the same brood, of equal size and of almost identical appearance. They were kept in a clean yard on a pleasant slope with trees for shade. They had plenty of food and clean water, and room for exercise. They had nothing to fight about, but their spurs were growing; and since spurs have but one function, it was a safe inference that in time they would be used for fighting. So I watched the two birds rather closely, and from them I learned something of correct, sportsmanlike fighting.

The fight began with the assumption of superior airs, with boastings, as it were, and with threats. The two began walking around each other, looking askance at each

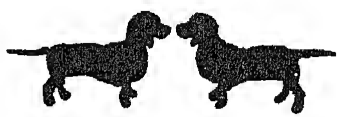
other, and saying things. At times there were nearer approaches, with beaks presented as if for frontal attack. Never was there any attempt on the part of either bird to strike the other off guard, or to take any mean advantage. Always each gave the other fair warning.

At length they fought. At first they sprang into the air and tried to strike each other with their spurs. When too much exhausted to rise from the ground, then they stood still and pecked at the top of each other's heads.

The first few rounds were indecisive. Time was called and after resting and feeding and resurgence of spirit, the fighting was renewed, each time with all the formality of the opening round. Each round ended with bleeding heads and with complete exhaustion. The last one ended with both combatants dead, the tops of both heads pecked off.

It is not often that a fight ends in such complete satisfaction: the objectives of both combatants fully attained. Usually one prevails as victor, and the other is vanquished and subdued.

Dogs also appear to have codes of honor, and bulls and stags as well, and even fiddler crabs.



Men are moved to fight just as animals are by desire for dominance. Opposition angers them, and passions mount until they find release in action. The controlling emotion is anger. They must "get mad enough to fight" before they are prepared for war. Thus instinct operates.

The violent action called for in a fight is provided for

in the physiology of the vertebrate body. When an enemy or any great danger confronts, the brain automatically sends out impulses that set going preparations for the struggle. The heart beats faster, as every one knows; it sends the blood coursing faster through the system. Arterial pressure rises. Respiration deepens, increasing the oxygen supply, and the spleen discharges new red blood corpuscles to carry it, also to rid the body of accumulating wastes. The adrenal glands above the kidneys discharge their secretion into the blood, and this when carried to the liver, frees the reserves of sugar stored there. The blood stream carrying this rich food supply is shifted away from the digestive system to the muscles and nervous system.

Everyone knows from experience how quickly this shift is made—how impending danger ends muscular fatigue, restores tired muscles to readiness for action, how it destroys appetite and interferes with digestion. It is an automatic response putting the body in readiness for action, and preparing it for meeting the demands about to be made upon it. This is an excellent provision of nature, evolved through countless past generations to meet the dangers of life. The accompanying emotions are either fear or anger, and they put us in readiness either to run or to fight.

Thus the "decks are cleared for action," without our having to take thought of details. These are the processes that "summon up the blood."[3]

[3] A readable account of these processes will be found in W. B. Cannon's "The Wisdom of the Body."

Our instincts are the end product of nature's efforts to equip our species for self-maintenance. The willingness to fight for home and kindred is a virtue inherited from our animal ancestors. War is its perversion. It is, like cancer, a disease of exaggerated function.

Man is at times and in a small measure a reasonable creature, more often when alone or in a small group than when in a crowd. He is gentle enough when calmly purring or preening, when praying or pondering; but he becomes dangerous like the fighting beasts when his fighting instincts are aroused and passion rules him.[4]

THE FOLKWAYS OPERATE

War is a social enterprise, and provision for it is in the folkways. Man responds to fighting stimuli instantly and automatically, even as a moth flies to a lighted candle or as a water flea swims to the light. His wide range of mental activity has permitted the creation in human society of artificial stimuli that are wonderfully effective in summoning up the fighting spirit.

War stimuli are of three principal sorts.

1. First there are those that appeal to the eye. Beautiful flags are of universal appeal. Silken flags, brilliant in coloration and symbolic in design, when borne aloft at the head of a marching column, seem to typify the spirit of the group they lead. Warriors follow the flag.

Uniforms appeal to the eye. They are thought to be a necessary part of military equipment. Those who should know maintain that an effective army would be well nigh

[4] Hamlet: "Though I am not splenitive and rash,
Yet is there in me something dangerous."

impossible without uniforms. They make the soldiers look alike: look as if imbued with one common purpose. Unsoldierly conduct disgraces the uniform.

Soldierly bearing in the individual, and military precision in the maneuvers of a group also appeal to the eye, and they create the impression of power.

In days gone by all the resources of art have been employed in providing stimulating accessories for the panoply of war: in devising banners and pennons, plumes and chevrons, oriflammes and chaplets, garlands and palms and laurel wreaths, etc., without end.

2. There are stimuli that appeal to the ear, and of these the sounds of bugle and flute and fife and drum are most effective. Military bands include many kinds of percussion and wind instruments. Stringed instruments seem not well suited to stirring up the fighting spirit; for the call is not to composure, but to action.

There are appeals to the ear for all occasions. War songs afford the soldiers a ready means of mutual stimulation, and a feeling of comradeship in a cause. War cries summon to attack. War whoops initiate the fury of combat. And if casualty befall at the last, the tatoo of muffled drums brings honorable obsequies.

3. There are stimuli that appeal to the mind, and these are the most effective of all in stirring us to eagerness for warfare. From the dawn of history until the present hour a most marked psychological characteristic of mankind has been group pride, or racial conceit (ethnologists call it *ethnocentrism*), manifest in the behavior of group members toward each other as contrasted with their behavior

toward outsiders: brotherhood within, enmity without. Federation, whether of families, tribes, or nations, has made for peace and cooperation inside the group and for war and conquest outside. Every group exalts its own heroes, its own traditions, its own folkways, and looks down upon those of outsiders as inferior. Outsiders are a "lesser breed." Their ways differ from ours, and are therefore necessarily wrong!

Even in America, where ties of blood unite our people with all the nations of Europe, the same group spirit prevails. Newcomers in our midst are called names, called uncomplimentary names such as "Dagoes," "Wops," "Huns," "Heinies," "Kikes," etc., until in a second generation they have mastered our language and assimilated all our folkways, and have lost the differences that were the signs of their "inferiority."

Across both friendly international borders of our country uncomplimentary names are hurled: northward, "Canucks" on one side, and "Yankees" on the other; southward, "Greasers" on one side, and "Gringoes" on the other. How we relish the slogans that extol our traditions, our glorious history, our prowess, and our "MANIFEST DESTINY"! Our folkways abet and glorify our fighting propensities by all the arts of stimulation that age-long strife has engendered.

Nobody wants war, yet collectively we seem to be unable to avoid taking the fatal steps that lead us into it. Subjected to the accustomed war stimuli, our instinctive fighting propensities are aroused and we cannot withhold the fatal reaction.

This is the way war starts: The people are at peace. They go about their business. They know where their living comes from and how to get it. They ask only to be let alone and not taxed too much. International enterprises thrive and good feeling prevails. Then some small offense is committed and preparedness begins. It is by nature cumulative; every advantage gained by one side must at once be surpassed by the other. Thus armaments grow, always for defense; and, like the cock's spurs, they have but one function: fighting.

Meanwhile the people on both sides begin proclaiming their desire for peace, while sanctioning more armaments as needed for security. They hold great peace meetings, and pass resolutions.[5] But propaganda starts, each side against the other, and like increase in armament it is cumulative. Restrictions begin to be imposed (with most righteous intent) against any news favorable to the morals or the purposes of the other side, and enmity grows by what it feeds on.

Then a major offense is committed, one that is a violation of rights and of national honor. The impulse to hit back surges. War is declared, and we are all for it (if any resist they are put in jail). Most of us are by this time eager for it, excited, elated, confident of our superiority in arms and valor, and so complacent in the righteousness of our cause that we call God to witness it. Whoever we are, this is what we of the human species do.

Let us recall how as a nation in 1914–17 we were pre-

[5] I commend for reading on the subject of peace resolutions *The Story of the Deluge, and how it came about,* in "Uncle Remus, His Songs and Sayings," by Joel Chandler Harris.

pared for participation in the World War. We had been assured that there was to be no more war, for a number of excellent reasons: 1. It was outgrown; 2. It was unprofitable; 3. Inventions had made it too terrible; 4. There were much better ways of adjusting international misunderstanding.

Then in Europe a war started between nations that had been arming only for defense. For two years we waited and watched its devastating fury, determined to keep out of it. In 1916 we re-elected Woodrow Wilson president of the United States because "he kept us out of the war" (this was the effective slogan of that political campaign).

Meanwhile, however, we were taking sides. While our government was observing strict neutrality, our people were losing poise. Newly coined epithets (*"Boche,"* etc.) from the trenches in France were heard on our streets. Fears arose that our own future safety was threatened. Further preparation for defense was feverishly undertaken.

The *Lusitania* had been torpedoed upon the high seas with loss of American lives. Further invasions of our national rights followed, arousing storms of protest. Our flag was insulted. National honor seemed threatened. National spirit surged. When in 1917 President Wilson told Congress "We cannot choose the way of submission" the country at large was with him. Congress declared war. Wilson's choice was made (as his Navy Secretary, Josephus Daniels, years later in retrospect truly said) in accordance with "the rising mandate of the people."

A strange exhilaration of spirit ensued. Flags flew out everywhere. Mass meetings were held, and war propaganda flourished. Slogans were heard on every side. Our youth rushed forward to train for battle; and when the bands began to play and the soldiers in uniform, "Our Boys," in serried ranks went marching down the street, their quickened footsteps adding to the rhythm of the music, how we were moved to action! How quickly our feet fell into step with the music! How our spirits rose! The restraining hand of the social order was lifted and we were free to hate, and to cultivate war madness.

Yet how artificial is all this hatred! After the World War ended one of the soldiers stationed in Germany with the army of occupation, in what had been the "enemy's country," was surrounded by a group of little boys and girls. Looking curiously at them he said, "Kids are kids. I don't want to cut their throats. Queer, ain't it?" And a goodly number of these soldiers later returned home, bringing with them German brides!

Even the reeking trenches sometimes witness deeds of mercy, and often the sportsmanlike treatment of enemies.[6]

The best diagnosis of war that I have heard was given me in two words by a friend who is a physician in army service: "Mass Hysteria." What are the symptoms of hysteria in the individual? Great mental excitement,

[6] "It was a strange sight to see two [captive] Russians in an Austrian trench, surrounded by cordiality and tender solicitude. The big brotherhood of humanity had for the time enveloped friend and foe, stamping out all hatred and racial differences. It is wonderful how the most tender flowers of civilization can go hand in hand with the most brutal atrocities of grim modern warfare."—Fritz Kreisler in *Four Weeks in Trenches*, p. 75.

weakened will, irritable temper, craving for sympathy, unwonted credulity, strange sensibility to impressions according to source, and temporary inhibition of reason.

Before the great World War started, many were saying there could be no more war because the glamor had all gone out of it and its dangers had surpassed human endurance. But the dangers of war do not keep men out of it: they like it dangerous. In 1917 the horrors of the trenches with their vermin and blood and filth were already well known, yet our young men freely volunteered. All honor to their courage. Many a man wondered whether he would be able to endure the strain of it, but loyalty to his own prevailed.

There is no need to dilate on the horrors of the trenches, the barbed wire entanglements, the aerial bombing, the devastating barrages, the suffocating gases, or the bloody harvest of the ambulances. All these are well known. Nothing that the wild beasts ever do is so abounding in beastliness.

CHAPTER XVII

WAR (*continued*)

REASON FAILS

"Shall the sword devour forever?" This was the question that Abner asked of Joab in a little Judean war between two kings more than two thousand years ago. And then he added an admonition that the world has been slow to heed: "Knowest thou not that it will be bitterness in the latter end? How long shall it be then, ere thou bid the people return from following their brethren?"[1]

Wars continue. They bring out the worst and also the best that there is in human kind: on the one hand, profiteering, intolerance, calumny, cruelty, and plain bestiality; on the other, courage, loyalty, quiet endurance of hardship, faithfulness to duty, and for many, sacrifice even unto death. They waste the world's substance, spill the nation's best blood, sow hatred, entail poverty and misery. In modern warfare both victors and vanquished lose. What then is the meaning of this strange irrational behavior?

War has had its uses in building up human society in the past. Our understanding of it will not be helped by ignoring the good that has come out of it.

[1] The Bible: II Samuel, 2: 26.

1. Once it put a premium on strength of body. When men fought in hand-to-hand combat it tended to the survival of the physically fit and made for the betterment of the breed.

2. Always war has compelled cooperation, with organization to make the cooperation effective. It is conceivable that ten unorganized men might fight ten others; but ten thousand men certainly could not effectively fight another ten thousand without organization. Military efficiency is no mere idle term of laudation when it comes to the handling of masses of men.

3. Always war has created a strong feeling of solidarity in the group. Nothing ever so unites a people in one common purpose as the summons to war against a common foe. Kings and emperors have always understood this, and often they have forestalled an insurrection at home by finding an enemy abroad and starting a foreign war. "Nations have found cohesion in war and dispersion in peace."[2]

Now, having admitted that certain benefits have come to mankind out of the wars of the past, and freely granting that in a lesser measure some of them inhere in it still, I would like to present my real opinion of modern war by means of a homely illustration.

When I was a small boy on an Illinois farm a peculiar task fell to my share in haying time. My uncle mowed the clover in the field with a two-horse mowing machine, and left it lying in the swath for half a day to cure in the sun before raking it into windrows. Between the mowing

[2] Rear Admiral Yates Sterling, Jr.

and the raking it was my job to destroy all the bumblebees' nests in the field. When the sickle bar of the mower passed over a nest the bumblebees swarmed forth promptly and thus the location of the nest was revealed; when they returned from this brief foray it could be marked for destruction.

The method that I used was one well known to every country boy in that region. Its use required discretion, for bumblebees are well armed, well organized, and overflowing with patriotic zeal. They sting fiercely, and are absolutely fearless in defense of their home.

When all the bumblebees had returned home after the first disturbance and had entered their underground nest in the grass I would take an earthen jug partly filled with water in one hand and a pitchfork in the other hand and go cautiously to the nest. First assuring myself that no bees were in the doorway and ready for action, I would set the jug carefully down beside the nest, and then thrust the fork into the soil under the nest and give it a twist. Then I would run, and run *fast,* to some distant shelter from which to watch further proceedings in safety.

The warrior bees would promptly swarm forth seeking the enemy that had wrecked their home. Round about the nest they would fly in widening circles until a distance of about a stone-throw on every side has been covered. No enemy being thus discovered, they soon began narrowing the circles, returning homeward, searching the same ground over again. Soon they were whirling in a vortex-like formation over the nest. There sat the jug, the one strange object in the field. Clearly their

attention was on it. Closer and closer they circled about above it. Then one made a dash at the mouth of the jug (did the black hole with the shining surface behind it look like the eye of an animal?) and fell helpless on the surface of the water inside. Another quickly followed, and another and another, and soon the whole whirling company was going down single file headlong in one continuous procession. It was like the performance that one sees when swifts enter a chimney in the evening on going home to roost. Soon all the bees were inside afloat and helpless.

When bumblebees' wings are wet, they cannot fly, and up the glazed inner surface of the jug they cannot climb. Once all were inside, it was safe for me to return, and easy to destroy the entire colony.

These hapless bumblebees remind me of the hapless humans that go to war, half dumb and wholly blind, but doing their utmost for an ideal. At the close of the great World War there were millions of young men in a plight as sad as that of these bees, as a result of a general management of public affairs that was just as stupid and just as futile.

Of all sad memories of the great World War none are to me so sorely depressing as the memory of what happened to the young men from my laboratory in the early days of their training for war. The call to arms came, and they volunteered almost to a man. They enlisted in early April, and in May and June we unavailable ones who remained in the laboratory could look out from our windows and see them on the greensward of a playing field

below, undergoing training. These fine gentlemanly fellows, kindly and courteous as we had known them, eager to equip themselves for a share in the progress toward a better world, were now being trained in the art of stabbing men with a bayonet. And shortly thereafter they were taken to a Plattsburg camp for more intensive training, a most important part of which was psychological, training to think that the dominating purpose of their lives must be to kill Germans. To this end they must thoroughly hate Germans. Such training appears to be necessary, for the beastly acts of inhuman butchery that have to be performed in order to win in battle can only be done under the drive of a maddened and insensate mind. All thoughts of human brotherhood must be banned.

Thus were their youthful dreams of peace and progress in knowledge supplanted by actualities of intellectual and moral squalor.

The causes of war are problematical. The Scotch have a grim way of stating facts in absence of explanations. They are credited with giving, as the normal course of events in history, this succession: first, there is war, followed by poverty, then by peace, by prosperity, by mounting pride, and then there is war again. History confirms. Surely this is a stupid course; and many have been the attempted explanations. The causes assigned for war are as diverse as are the interests of their discoverers: economic advantages; territorial ambitions; racial animosities; overpopulation, etc. In my judgment these are all merely alternative stimuli, any one of which will serve as an excuse for aggression when a nation is well fed and

well equipped and emotionally ready. Back of them all are the untamed animal instincts, the desire to rule and the willingness to fight. Perverting these instincts from their normal life-saving functions are the evil folkways that engender international strife. It is surely inflamed emotion and not economic advantage,[3] or any other reasoned cause,[4] that is forever threatening the peace of the world.

War starts with reason in abeyance. Fears intensify our rage. Brotherhood is forgotten. Our friends and colleagues beyond the border at once become our enemies.

Emotions accompany all our instinctive acts and it is emotions that move us, not reason. Reason is too cold, too slow, too uncertain in its conclusions and in its operations. Reason sees all, knows all, but does not rule. Reason sits in the outlook tower, but the seat of control is elsewhere. Reason sits in isolation, assumes superior airs, and is contemptuous of the world where force rules. Reason decrees in impotence while inflamed emotions run riot. Reason is lacking in weapons, never having seriously undertaken the task of implementing itself.

The great international need is that force be applied not to war but to war-prevention, and be directed by the best intelligence of the world to the restraint of turbulence in the interests of peace and justice.

The fighting instinct is a part of our animal inheri-

[3] "As long as man is a mortal and fugitive creature, an unfathomable mystery to himself, he will be capable of violence for ideals, emotions, dreams, and fantasies which have nothing to do with any thought of material profit."—J. L. Garvin in *The Economic Basis of Peace*.

[4] "Interests always compromise: passions never do."—Alain.

tance: a goodly part when properly directed. It is inseparable from us. It cannot be eradicated from our nature. The fighting spirit will continue to be aroused among nations as among individual citizens. Force under intelligent and responsible direction is obviously needed to restrain its madness, and to guide its unbounded energies toward useful ends.

Folkways will ever rule us; but folkways, unlike instincts, may be changed. They are not inborn; they are the products of our environment. It is not at all likely that the call of Marco Bozzaris, to

> "Strike for the green graves of your sires;
> Strike for your altars and your fires;
> God, and your native land,"

will ever fall on unresponsive ears. But it is to be hoped that national security may yet be established by means that do not stir up strife with neighboring nations.

A better way has been found in smaller groups. Once mankind existed in clans that were always at war, or recovering from war, or preparing for war.[5] Comradeship existed only within the clan: all outsiders were potential enemies. With improvement in means of livelihood, the groups grew larger. Clans grew into tribes and tribes into nations. Each became a peace group in which cooperation, law, and order naturally developed. Substantial benefits resulted. Some sort of *high command* was always

[5] "The wretched Fuegians, the miserable Australians, with really nothing worth living for, let alone worth dying for, fall to cutting each others' throats the moment that tribe encounters tribe."—D. G. Brinton, in *Races and Peoples*, p. 76.

established *for putting force to keeping the peace.* Thus order was maintained and conflicts of interest were adjusted.

There is, of course, unavoidable initial difficulty in establishing such control. It is like the local difficulty in a rough, unorganized mining camp after a gold rush, where everyone is a law unto himself, and where a vigilance committee must first be formed to compel order. The volunteers to service on vigilance must take risks and make sacrifices in the cause of peace and order.

Meanwhile everyone must go armed while complete disorder prevails. None can afford the sort of pacifism that invites piracy. He who refuses to fight for himself and his group is preparing the way for the ruthless and powerful aggressor.

The world would be much nearer peace today if our leaders gave more heed to the animal behavior of our species, and were willing to face the fact that instinct in man as in animals yields only to force. They would then be more ready to take measures for applying force to keeping our emotional drives within safe limits. Locally, when police are on the job we give our weapons to them, and soon find how few weapons we then need ourselves. Is it not strange that with nearly all the world longing for peace and orderly living, the intelligence of the world has never yet been applied to *implementing* a high command to preserve international order?

Instead, our representatives hold peace conferences, and pass resolutions; our governments hold disarmament conferences, and go on arming. When ruthless leaders

start a new rampage, the world, aghast but impotent, contents itself with issuing righteous judgments; and having no means of enforcing its judgments, it feverishly builds new armaments, and prepares for participating in the carnage. Surely recent events have demonstrated the entire futility of moral suasion as a means of controlling animal desires. Reason did not hinder the coming on of the great WORLD WAR. Even now it is powerless to check the present strife.

The one means the world has found for establishing peace within a group is the intelligent application of force: delegation of the fighting duty, and allocation of the fighting equipment to a highly trained fighting service, under control of a single morally and socially responsible high command.

And when disturbance threatens there must be promptness in the application of that force to check disorder in its small beginnings.

Shall this Spectre of Hell on Earth—
this sign of vanished chivalry—
this witness of the blowing out
of all the moral lights around us—
this darkest blot on Human History-
Shall this be the distinguishing mark
of our Day and Generation?

Or shall we *implement* reason
for keeping the peace?

Chapter XVIII

GOVERNMENT IN ITS BIOLOGICAL ASPECTS

We now come naturally to the consideration of government; for governments make war. War is a social enterprise; an application of force to the settlement of group disputes.

The warfare of the social insects, ants and bees, appears to be purely predatory, merely organized pillage. Like all the other activities of these animals, it is inherited behavior peculiar in each species, automatic in performance, and unchanging. It is therefore less significant for us than is the strife of animals that are more nearly akin to us, and we will pause here only to quote a single vivid paragraph from Professor J. H. Comstock's description of the perfect government of the anthill.

"If the statesman or the philosopher would study a perfect communistic society, let him throw away his histories of poor human attempts and go and study thoroughly the nearest ant-hill. There he will find no love for friend or wife or child, but love for every one. There everything is done for the good of the whole, and nothing for the individual. The state makes wars, provides the food for all, cares for the children, owns all the

property. He will find no complaint against the existing condition of society, no rebels; but the fate of each one is determined by the accident of birth, and each takes up its work without a murmur. He will find that this perfect commune has developed courage, patriotism, loyalty, and never failing industry; but he will also find that war, pillage, slavery, and utter disregard for the rights of other communities and individuals are as prevalent as they are among our own nations, where selfish private ambition has held sway so long."[1]

FORESHADOWINGS OF GOVERNMENT

Man's place, zoologically speaking, is among the higher vertebrates. In the behavior of some of the more social of these there are foreshadowings of government: not organized government as we understand it, but the raw materials for it: trends in behavior that lend support to orderly association of numbers together. Let us now note some of these trends.

1. All social animals have developed tribal instincts. They commingle for pleasure, and seem to have a feeling of kinship. They do not enjoy isolation from their kind, even with full provision for all their physical needs. They protect each other from enemies; for when one is disturbed the others are warned. They are happiest and safest in companies. In numbers there is strength and mutual support in resisting enemies, and there is conservation of energy in the rearing of the young. Numerical increase multiplies the powers of the individual, whether

[1] *Manual for the Study of Insects.*

these powers be in swiftness, strength, endurance or cunning. Mutual stimulation is likely to enlist whatever intellectual faculties the members of the group may happen to possess.

2. Social animals seem to have developed a feeling of mutual dependence between the members of the group. When a few crows engage in the raiding of a garden, a sentinel seats himself on outpost duty and looks out for danger, while the others enter and seek their food. When a tribe of African monkeys leaves its famine-stricken home in the forests and goes down to the seashore to seek an emergency ration of clams, a sentinel is posted on a high point overlooking the shore. Monkeys are far safer in the treetops than on the beaches, and must be promptly warned if an enemy approaches. The sentinel is just as hungry as the others are, but he dutifully waits and watches, staying at his post until relieved.

3. Social animals have developed a feeling of group solidarity that is manifest in community of action. Thus when a stranger in Somaliland comes upon a company of Brockman's baboons, and the entire company is thrown into a state of great excitement, some old male "will seat himself upon a high vantage point so as to overlook all below him, while expressing his disapproval of the presence in his dominions of the foreigner, not of his class, by angry barks and grunts. At the same time he keeps a sharp eye upon the intruder's movements and issues his orders to the rest of the band, as to the imminence of danger, and the proper methods for them to adopt in order to escape it. When it is evident that it is the

stranger's intention to cultivate a close acquaintance with the rock-dwellers, the order for flight is given, and the panic-stricken members of the band scamper away over the rocky heights, those of them too young to keep up with the rest, clinging to the mother's body with arms and legs. The sentinel delays a moment after the rest have started, and then, ejaculating one more swear-word, takes up the line of flight making the best time he can, but stopping occasionally to anathematize his pursuers."[2]

4. Social animals have developed a sense of dependence on leaders along with a feeling of responsibility on the part of leaders for the welfare of their troop. This may be seen in the behavior of a flock of chickens. The cock, who has won his way to leadership by fighting prowess, is looked up to by the group for news of the world and for protection. He evidently feels his responsibility as guardian of the group. He dutifully scans the sky for hawks and the hedgerows for cats and other prowlers, and promptly and loudly gives warning of any approach of danger.

The bull in the pasture on the approach of a stranger, steps forward to the head of his flock and stands guard.

5. Many animals have developed a sense of proprietorship of domain. Fitzsimons says of the troops of vervet monkeys in South Africa:

"I have never yet met two large troops of monkeys in the same locality. They seem to have their districts as carefully marked as is the case with us. Should a troop encroach upon the territory of another clan, then war is

[2] Quoted by Elliott: *Review of The Primates,* 2: 149.

declared, and the intruders are either driven forth, or the rightful owners are obliged to retreat. The history of the monkey-folk in this respect is exactly similar to that of man."

It is well known to every careful observer of the ways of birds in their nesting season that each pair preempts an area about its nesting site, and holds it against intruders. The song of the male is a proclamation of his sphere of proprietorship, and a warning to other males against trespassing. Those who manage game farms know that crowding of quail will interfere with their breeding. The area of brushland available must be sufficient to provide each pair with its own exclusive domain.

When a dog attaches himself to a household he soon learns the bounds of the area that is regularly occupied by the members of the household, and sets himself to guard it. His barking at passing vehicles is not to him mere foolishness: it is guardianship. When he has driven the speeding car clear of the premises, he returns, satisfied, having done his duty.

6. Social animals have attained to a considerable degree of cooperation in some of their business enterprises, mainly the primeval occupations of hunting and fishing. It is well known that wolves hunt in packs and that the members of the pack support and supplement each other in overcoming their prey.

White pelicans conduct fish drives cooperatively. I have watched them on Elsinore Lake in southern California. A dozen or more of these huge birds get into line and start swimming shoreward, driving the fish ahead of

them. The fish instinctively flee before them and try to keep out of reach of the hooked tip of their long beaks.

The drive starts well out from shore with the birds wide apart. It sweeps over a considerable area, with the birds about equally spaced, and lined up in a curve like that of a seine in action, the ends proceeding shoreward in advance of the center. As the shore is approached the birds come closer together. The fish are thus concentrated ahead of them; and, finding themselves hemmed in between the pelicans and the shore, they dash about wildly, and sooner or later, make a break through the line of birds for the open lake. The alert pelicans are now close enough together so that the fish in eluding one of them is likely to swim within reach of another. This affords the opportunity that is the objective of the drive. It is an excellent cooperative effort.

7. Leadership among social animals is developed by a selective process, much as among men. This was noticed by Addison in the behavior of a pack of hounds on a hunt. He says:

"I was delighted in observing that deference which the rest of the pack paid to each particular hound, according to the character he had acquired among them. If they were at fault and an old hound of reputation opened up [bayed] but once, he was immediately followed by the whole cry: while a raw dog, or one that was a noted liar, might have yelped his heart out without being taken notice of."[3]

Leadership depends on *character:* character as ex-

[3] Sir Roger de Coverly Papers; the *Spectator,* No. 116.

pressed in reliability, and in responsibility toward those led.

DISRUPTIVE TRENDS

The foregoing trends in animal behavior seem to favor the orderly association of numbers together in a social group. Alongside these there may be seen disruptive trends that stand in the way of peaceful association. Let us now note some of these.

1. *Racial antipathy.* As mutual tolerance and cooperation grow within a group, distrust and enmity may arise toward outsiders. It is a lamentable fact that love of kind seems to be often accompanied by hatred of other kind.

When my dog first gets out on the lawn in the morning he goes sniffing about for any news items that the scent of the ground may carry. When he comes upon the trail of a member of the family he wags his tail; when he meets with the trail of a trespasser, his bristles rise and he growls a little.

When a queen bee is introduced into a queenless hive she must be confined in a little cage for a time until she acquires the scent of the hive; otherwise she would be quickly destroyed as a foreigner by the worker bees. The roots of racial prejudice are in this feeling of antagonism toward outsiders.

2. *The "herd instinct."* Increase of numbers seems to favor the spread of emotional disturbances. The herd fighting instinct is easily roused, and its intensity seems to be somewhat proportional to the numbers of individuals involved. The distressed squeal of a little pig is sufficient to set a whole large herd of swine into instant uproar.

When Koehler tried to enforce orderly behavior on unruly individuals in his colony of apes he encountered difficulty. He says:

"The moment your hand falls on a wrong-doer, the whole group sets up a howl, as if with one voice. At times the most insignificant episode between man and ape which arouses a cry of anger, is sufficient for a wave of fury to go through the troop; from all sides they hurry to join the attack. In the sudden transfer of the cry of fury to all the animals, whereby they seem to incite one another to ever more violent raving, there is a demoniac strength. It is strange how full of moral indignation this howling of the attacking group sounds to the ears of man; the whole group will get into a state of blind fury, even when most of its members have seen nothing of what caused the first cry, and have no notion of what it is all about."[4]

How like unto the behavior of men in nations when they go to war!

3. *Contention for power* is ever a chief disturbing factor in social groups of animals, as it is in groups of men. The place of power is nearly always in dispute. It is never filled for long; for life is short, and in time new contenders arise on every hand. Government has been called the device by which we protect ourselves from one another. Far back in animal society arose the eternal political question, "Who shall rule"?

NEGLECTED ASPECTS OF HUMAN MENTALITY

We are not here concerned with the forms or the methods of government, but only with the basic zoologi-

[4] *The Mentality of Apes*

cal materials on which all government must operate, and by which it is limited. Government must control citizens with all their emotional urges, their waverings between allegiance and independence, and their haltings between doing or not doing as the ruling power directs. Government must control in accordance with human nature.

Perhaps we may again learn something by comparison of human mentality with that of gregarious animals; for there are differences among these that appear to determine their fitness for sharing in the conditions of civilized life.

Of the wild animals that are tameable very few have been domesticated and made our servants. The few are isolated members of great groups of gregarious mammals. For examples:

Among the canines the dog has been domesticated and the wolf has not.

Among the single-hoofed mammals the horse has been domesticated and the zebra has not.

Among the bovines the cow has been domesticated and the bison has not.

Among the pachyderms the Asiatic elephant has been domesticated and the African elephant (save in rare instances) has not.

Among the cameloids of South America the llama has been domesticated and the vicuña has not.

And may we then add that among the Primates man has been domesticated and the hanuman monkey has not.[5]

[5] "What can you do with a monkey? He falls outside the dominion we claim over the beasts of the field. It is useless to think of exploiting him as we do our fellow creatures. He will neither pick cotton nor tend a machine. There is no bringing him within any scheme of comprehensive human interest."—John Kent, in *Gentlemen's Magazine*, 51: 158, 1893.

The domesticable submit more or less willingly, first to physical restraint, and ultimately to guidance, according to the measure of their mental adaptability. The others resist control, even unto death.

The domesticable ones are all fighting animals, that determine rank within their social group by individual prowess. Every fight results in submission to the victor by the vanquished. The group victor becomes the group leader. His will becomes law. He is the government.

The pleasure is mutual.

Man is born a wild animal and civilized nurture can only partially tame him. His instinctive urge to dominate others is coupled with a willingness to yield obedience to the strong when circumstances require it: not merely submission but also allegiance and support; and when these divergent trends reach their peak man may become the most cruel of tyrants, choosing

> "To wade through slaughter to a throne
> And shut the gates of mercy on mankind."[6]

or he may become the most long-suffering of beasts of burden;

> "Bowed with the weight of centuries, he leans
> Upon his hoe and gazes on the ground,
> The emptiness of ages in his face,
> And on his back the burden of the world."[7]

[6] Gray's Elegy in a Country Churchyard, stanza 17.

[7] These are the opening lines of Edwin Markham's *The Man with the Hoe,* that was written after seeing Millet's world-famous painting of the same title.

swamped by public enthusiasm and an invasion *en masse* would have hailed him as its hero."[9]

Organization among the females of a social group, though different in certain aspects, shows the same signs of desire to dominate, with even greater rigidity in observance of rank and station. This may easily be seen in a flock of hens, if individuals are marked so that they may be recognized quickly, and if they are watched carefully. It will be seen that there is a peck-order among them to which the members of the flock rather strictly conform. When two hens meet, one of them advances as if to peck, and the other gives way. A careful tabulation of the peckings and peck-avoidances will reveal that the hen of the highest rank holds the right to peck every other hen in the flock, disputed by none; and that among the other hens there is an established pecking order: also that at the foot of the social scale there is one poor hen that may be pecked by every other hen in the flock without making even mild remonstrance.

Supremacy in the higher ranks of the pecking order is established in the beginning by actual fighting. A hen can deliver a severe stroke with her beak; one that will draw blood or knock feathers from a rival. In the lower ranks a mere show of prowess (sheer bluffing) may succeed; but the social hierarchy, however established, is maintained with surprising constancy. Dr. W. C. Allee says that such organization is more firmly fixed among hens than among cockerels.[10]

[9] *Gentlemen's Magazine*, 51: 161–162, 1893. Clearly, the last few sentences state not facts, but *inferences.*

[10] *The Social Life of Animals*, p. 179.

Government takes origin in the animal instinct to rule. There can be no government without rulers. In men and animals alike the strong naturally assume leadership; the others follow. The strife that develops the strong leaders engenders in the others the willingness to be led; it is perceived by them that fighting a common enemy is better than fighting each other.

The social order begins in cooperation for defense and in sharing the means of sustenance.

When with advancing knowledge the invention of tools and weapons had made possible larger groupings of persons, and clans were merged into tribes with a chieftain and graded subordinates, then real government, as we understand it today, began. To this animals have never attained. But government, even its highest development, has never one whit altered the nature of the human animal. Inherited instincts are the springs of his conduct still. Social activities are still a compromise between the better and the worse elemental urges of his animal nature: on the one hand love of peace and love of kind; on the other, selfishness and cowering fear.

Under the surface of our civilization that has been evolved with the folkways, and only a little tempered with a touch here and there of rationality, man in the mass is still predatory. Whenever government fails the populace immediately reverts to the ways of savagery, and indulges in pillage and riot. Social chaos ensues, and the people in confusion follow the leader[11] who promises their best

[11] "Public opinion will support anybody who shows power by securing results."—A. G. Kellar, in *Man's Rough Road,* p. 165.

chance of future security. Government is necessary to safeguard the advantages of a social order.[12]

Government is concerned first of all with the biology of the human species; with the crises in human life on which its continuance on the earth depends; with births and marriages and deaths. After the folkways have taken care of the ceremonies proper for these events with general rejoicing at births and at weddings and sorrow at funerals, government provides for decent and orderly procedure in all the changes of circumstances that these events entail.

Government is probably at its best when it provides:

A minimum of control of personal affairs.

A maximum of aid to the individual in finding his share in the common tasks, and in establishing his understanding of common needs.

Equality of opportunity for all.

Government is our chief instrument of cooperation. It is the only one in which we all act together and which we all support. In other organizations, fraternal, educational, social, religious, or what not, we go our several ways and are divided into competing groups. To our government we look first of all for defense and for a measure of public guidance. To it we yield obedience and independence of action. Under it we assume responsibility toward others. By means of government we make common cause of our common needs, with all the other citizens of our national group.

[12] "The state comes into existence that man may live well."—Aristotle.

The reason for this is *force.*[13] Government begins and ends in force.

[13] The president of the United States is first of all Commander-in-Chief of the Army and Navy (Constitution of the U. S., Art. III, Section II, Paragraph I).

CHAPTER XIX

GOVERNMENT (*Continued*)

THE POWER BEHIND THE THRONE

Society is a product of nature. No one planned it. No one controls its course. Like an organism of a lower order, society does things in and of itself, subject to the conditions of environment and to the limitations that inhere in the nature of its constituent persons. Out of the collective behavior of these persons social behavior proceeds, without their planning and without their leave.

Let us remind ourselves that the four chief components of social behavior discussed in Chapter XIII are ever operating. There are the physiological responses that are essential to keep life going, that are fixed, automatic and compelling, that underlie and condition all else. *The driving force in human affairs is here.*

There are the instincts, that provide for the upkeep of the species, that rule in predetermined ways, automatically, but with consciousness of performance. Their exercise is not essential to mere living. Life may go on if instinctive urges are not fulfilled, but it will be largely shorn of its zest; for emotions accompany instinctive activities, and it is our emotions that move us, and give

us a sense of sharing in the life of our race and kindred. Nature has put in us the rewards for the actions that are necessary to keep our species going. *The deep springs of human conduct are here.*

There are the folkways, that are social habits. They are acquired as we have seen, by the slow and blundering method of trial and error, and they are extended by imitation and general acceptance. They soon become relatively fixed and compelling, but are not unalterable. They provide guidance for instinctive action, keeping it within proper limits. They are the chief concern of society. They condition cooperation and mutual understanding. Not much social life would be possible without them. *The foundation of the social order is here.*

And there is reason—something superadded to the folkways, contemplating their operations, weighing their effects, pronouncing judgments, and from its high tower of isolation, seeing the changing world of human affairs go along in its old ways, changed through the ages only a little in outward circumstance, forever unchanged in its essential nature. Reason can do nothing to change physiological processes. It cannot suppress instincts; it can only seek to guide their operations in safe channels. It cannot on the instant remake the folkways, but it can weigh their aims and consider their results and slowly improve their action. *Social control should be here.*

In order that the beneficent work of reason may go forward it is necessary that we should give heed to some of the biological conditions and limitations under which reason must ever operate. Governments change, but the

nature and needs of the governed remain forever the same. Behind all successful government is natural law.

The problems of social control are mainly those of organization and administration.

ORGANIZATION

Much light is shed upon the problems of organization by the study of nature's supreme model, the body composed of cells. These are the units of a lower order, that correspond to the persons composing the body politic. In our own bodies they are so highly integrated and their operations are so unified that we can scarcely think of them as distinct parts which have been able to get on together by reason of improvements in corporate organization. Yet our life is at bottom cell life, and all our activities of body and mind are the result of the coordinate functioning of the component cells. Moreover, these cells begin their existence in comparative independence, and differentiate, specialize, and merge their interests and find their several places and functions as the body grows.

The grades of organization among cells and the resultant forms of animal life are hardly more diverse than are the forms of political organization which have accompanied the social efforts of mankind.

So close is the parallel between the multicellular animal body and the body politic and so numerous are the points of likeness, that one cannot study it without becoming aware of the existence of general laws of organization. Mere increase of the mass imposes division of labor, for some individuals are thereby crowded away

from the sources of livelihood: some therefore (be the units cells or persons) must gather, some must transport, some must fabricate, though all must use.[1]

As the growing multicellular body acquires vessels and ducts so the growing civic population acquires channels of transportation and for like functions: for the distribution of supplies and for the disposal of wastes. As the physical body acquires a skeleton for support and maintenance of the growing mass, so the body politic acquires institutions for the same purpose. As the body develops nerves for prompt communication between distant parts, so the commonwealth develops the telegraph and other means of intercommunication. As the cells develop blood and lymph as media of exchange, holding the products of the labors of all in a reserve to which each contributes according to its ability and from which each takes according to its need, so the people devise money to meet like social needs. As the animal body develops sense organs, antennae and eyes and ears, to serve for the exploration of environment, to find food and shelter and to locate sources of danger, so society develops watchmen and seers and investigators. The watchman in his tower is as the eye of primitive society; the explorer and the investigator are the specialized organs of outlook of our own time.

Lastly, as the animal body develops control centers, massed nerve cells, ganglia and finally a brain, so the body politic develops control centers of various sorts, centers of commerce, of religion, and of government. In both alike the control centers are in communication with all

[1] "The eye cannot say unto the hand, I have no need of thee."—*The Bible*, I Cor., 12: 21.

parts of the body, and provide the means whereby the parts may influence each other. The centers also possess some powers of initiation, though they mainly control through the inhibition of such acts as experience has proved to be unprofitable.

There is thus, in a way, an hierarchy among the tissues. The cells of the nerve centers are in the seat of control; but if they rule, they also serve. Among the cells there is no aggrandizement except for service. If the body of one of the higher animals composed of cells be thus compared with a nation composed of persons, then the nervous apparatus of the body corresponds to a Department of Communications, with general headquarters (brain), local stations (ganglia), and wires (nerves) connecting all parts together and providing speedy contacts.

The likeness is not at all in the essential nature of the things that are here compared, but in the conditions that both have to meet, and in the way that they conform. Whales are not fish, though fish-like in form. The two classes of vertebrates that whales and fishes represent stand at opposite ends of the vertebrate phylum; but both live in the water, and both have acquired the streamlined form that makes for ease in swimming. The hummingbird and the hummingbird moth look alike as they poise in mid-air before flowers on almost invisible wings; but neither the long beaks with which they probe the deep corollas for food, nor the narrowly pointed whirring wings on which they hover have any structural likeness in the two. It is all superficial likeness; all adaptive; all conformation to the conditions set by nature for the sort of life they lead. The significance for us lies in their basic unlikeness.

Nature abounds in parallelisms: things that look alike but are not. Some are chance likenesses, and from an evolutionary standpoint, non-significant; but there is no mistaking the meaning of others. Streamlining for rapid locomotion is not accidental; it is required, and it is perfected in the competition of life. It is accomplished in the fishes by modeling of the body itself, and in birds by filling out the hollows of the body and extending the rearward slopes with feathers. When man began to make aeroplanes he found it necessary to stream-line them if he would attain speed. He had to conform to natural law.

Parallelisms generally indicate conditions set by nature, conditions to which all organisms, whether physical or social, must conform in order to live.

In every organization, whatever its components, *mutual dependence is the strong bond of union.* This is the first condition of peaceful and permanent association. Unfortunately, it is wholly at variance with what have heretofore been national ideals of self-sufficiency. If each nation had to continue to raise, to mine, to manufacture all that its own people require for sustenance and had to maintain defenses adequate to meet all comers, then permanent world peace would be forever impossible. The road to world peace runs in the opposite direction. Let the peoples of the earth make common cause of their needs of defense, as the parts of the body have done; let them progressively remove all artificial barriers to the fullest and freest use of the world's diversified products. Let them organize an agency of control to determine local conflicts of interest in accordance with the greater good. Let them

implement the control with weapons adequate to compel order: then world peace will be possible.

In union, strength is found. By cooperation, the common tasks of life are more easily performed. But increase in the mass makes for better living only as the parts of the mass come to function together harmoniously and each bears its share in meeting the common needs. *Mutual responsiveness is the true measure of organic efficiency.*

Peace is organic health.

If any organization is to attain to a high degree of efficiency its parts must be mutually dependent, having need of one another; and *there must be also some organ of control,* capable of requiring, for the sake of the larger interests of the body, that local disruptive quarrels shall cease.

The human race at large is unorganized, inchoate. Its elements are combined in heterogeneous units of varied size and composition that are not consistently either racial or geographic. It resembles a slime mold rather than a vertebrate, since the mass may be divided and its parts may be recombined arbitrarily. And yet, out of the mass there have emerged groups highly organized and highly efficient. The primal group is the family, firmly founded upon the one differentiation that Mother Nature has imposed upon us—the differentiation between the sexes. Combinations of families into clans and tribes grow out of the discovery of the advantages of cooperation in large tasks. Boundaries were at first determined largely by kinship, or by advantages of trade. With progress in agriculture and handicraft further compounding becomes

possible and nations are organized. Always the size of the group is directly related to conditions of living; complexity of organization follows upon increase in size. But, large or small, every group that has attained communal efficiency has followed these principles of organization. They inhere in the nature of living things.

ADMINISTRATION

In order to guide the energies of organized society in the way of mutual responsiveness and orderliness, administration must give heed to the native urges of mankind, and must seek to utilize the enthusiasms that instinctive activities call forth. Great enthusiasms cluster mainly about a few principal objectives. Broadly stated, the labors of men are mainly devoted to these five ends:

1. To making a living and the establishment of homes.
2. To rearing and safeguarding children.
3. To fighting, and contests for supremacy.
4. To feasting and celebrating.
5. To exploration and discovery.

Men are easily led to do things that promise fulfillment of these desirable ends.

The first two objectives are all-important; the maintenance of the species depends on them. The third involves the inevitable struggle for existence.

Men normally desire to get on in the world and to live peaceably with their neighbors. Most men are satisfied with the assurance of security and sustenance for themselves and for their families. A prophet of old envisioned

a life of simple contentment when he wrote: "They shall sit every man under his vine and under his fig tree; and none shall make them afraid."[2] Never in the history of the world has this ideal been realized for any length of time; for there have always been aggressors. Society has always had to protect itself from the excesses of the greedy, in primeval times from the bludgeoning of their brawn, in modern times from the scheming of their brains. The struggle for supremacy has gone up to a higher intellectual level. It is no longer the rage of rampant physical competition, but rather the passion for that kind of supremacy that is gained by the powers of the mind.

The two great disasters that continually beset civilization are wars and financial panics: the one a struggle for supremacy abroad; the other a struggle of like nature at home. Both are man made: they are not calamities imposed by nature (earthquakes, tempests, floods, etc), not the so-called "Acts of God." Rather, they are chastenings of man for his own excesses, perversions of normal and wholesome ambition. Both entail poverty and distress, losses of homes, visitations of despair upon the innocent, lowering of moral standards, and reversions to barbarism. Both are the culmination of drives of perverted emotion, with popular surges of unreason. Both have hitherto proved uncontrollable. In wars men flout law; in panics they observe the letter of it, but not its spirit. In both, when great leaders rise to power by playing upon the evil passions, prejudices and cravings of human nature, then society has dire need to be saved from some of its GREAT MEN.

[2] *The Bible, Micah,* 4: 4.

We have spoken of war; now just a few words about panics from the biological standpoint.

Panics are as modern as money and financial credit, but their cause is as old as the human race. They grow out of the struggle for supremacy as manifested in greed of gain. Dollars and not clubs are the weapons used.

Panics are promoted by the general fostering of a desire for sudden and unearned riches. There is an era of speculation, of ardent dollar-chasing, of reckless borrowing and spending, and of stupid efforts to get something for nothing. Then there comes a crash and a redistribution of the dollars. It is a process by which the savings of the many are swept into the pockets of the few; and the few are often those who have done nothing either to create the wealth or to sustain the public welfare. It is surely obvious that such procedures do not improve a nation either in *morale* or in morals.

The pursuit of money is in many ways like the pursuit of game birds by the hunter or the angling for trout by the fisherman: a pursuit with a dash of wildness in it that makes it fascinating; a pursuit of an elusive but very desirable objective; a pursuit that requires both skill and knowledge of the conditions of the chase; a pursuit of something that is limited in supply by the conditions that surround its production. The chase has great appeal to our excitement-loving, scoop-loving animal nature.

It seems not to have occurred to those who go gunning for dollars that the killing may be overdone; that there exists for them any responsibility for the preservation of the sources of wealth; that they are emulating the ways

of the "game hog";[3] that "bag limits" may be needed to save something for all—even for themselves in the end.

It is to be hoped that in business, which sustains society and all its institutions, there may be more of the enlightened selfishness that marks true sportsmen, and a better balance maintained between the give and get propensities of the human mind.

In the vast complexity of the social order of our own day it is easy to become confused and to lose grasp of basic principles. When living was simple, as in the early days of husbandry, and every man tilled his own field, each worked with his own hands to supply himself with food; he had to work or starve, unless he were willing to become an outcast by begging or an outlaw by stealing.

As our numbers have increased and our tasks been diversified and machines have been employed to do the work, and as we have come to work for money instead of goods, the direct dependence of livelihood upon labor has become obscured. But there is no way to get things produced except by labor, and wages are the means of distributing the fruits of labor. Collectively, we still have only what we produce.

Machines have also limited the laborer's independence of action. They are too expensive for him to own, and he must work for their owner. Each machine does the

[3] When in the United States in 1930 it was loudly proclaimed by some "statesmen" that the existing depression was due to "overproduction" a Kansas wheat farmer sketched a truer picture of the situation when he said: "Think of an island covered with groves of cocoanut trees and inhabited by monkeys, and some of the monkeys starving because there are too many coconuts!"

work of many men, and the wages that the machines earn by the things that they produce all pass through the owners' hands, and are at the owners' disposal. When one laborer is set to tending a machine that does the work of ten men, he gets only the wages of one man, as before. According to the will of the owners of the machine, the increased profits from use of the machine may go either to the public in cheapened products, or to the laborer in increased wages, or into the owners' pockets.

Every invention is a two-edged sword, cutting both ways, as it is wielded. Fire is equally available to the householder for warming his hearthstone, and to the incendiary for destroying his rival's barn. Money does good or evil accordingly as it is used. It is often detached so far from the labor that produces it that the primal wholesome feeling of responsibility for its proper use seems often to be lacking. The stock certificate is so far removed from the clang of pick and shovel that the connection between the two is lost sight of, and dollars become the pawns in a merry game at which men play with reckless abandon.

Both beneficent uses and sordid abuses of money spring from the possessive pair of opposed instinctive tendencies that are inseparable from our nature—the give-or-get pair (see p. 189). Money is a wonderful convenience and aid in either acquiring or bestowing property, power, prestige, or service.

Our social progress consists in using and sharing the resources and privileges of the good earth; and our iniquities and troubles arise mainly out of greedy and improper division of them.

Concerning the fourth of our list of five objectives little need be said. Feasting and celebrations are the means by which all social groups consolidate their gains and build up *morale* for further undertakings.

Concerning the fifth, exploration and discovery, much more should be said than space here will allow. Fortunately there are constructive urges in human nature as well as those that are possessive. There are great enthusiasms that are worthy of administrative encouragement: the zeal of the explorers and the discoverers and the developers and the promoters in science, arts, crafts and sports. Progress in these constructive ways is humane; it is more satisfying in attainment, and it leaves no trail of pain and sorrow in its wake.

From personal experience I can speak only of the pleasures and privileges of the naturalist: of him who seeks for knowledge of Nature's secrets as for hidden treasures; who finds beauty and order and fitness in every living thing; who discovers principles in which are revealed the secrets of orderliness and the keys to further discovery; and who finds in it all unending delight.

It is preoccupation with such interests as these that makes life worth living. It is the fostering of such interests that makes a people great. When nations meet together in great world's fairs it is the products of their science, art and industry that they proudly exhibit; not their cannon, or their flame-throwers, or their gâs masks.

Administration should not only see and know, but it should seek to give direction and control to the boundless energies that flow from the instinctive urges. It has be-

come habitual of late to scoff at emotion and to exalt reason; but surely, judged by many of its results, reason is a weak staff to lean upon. Reason wabbles: out of the contemplation of one and the same set of facts and circumstances reason makes both Democrats and Republicans; or both Modernists and Fundamentalists; or both Fascists and Communists; or both of any of the other opposed groups whose names are spelled with Capital Letters by their adherents. It would be highly educative to any person who has full confidence in the operations of human reason to be privileged to sit in on a few university faculty meetings, or a few sessions of senate, or parliament.

Man often uses his reason merely to substantiate his beliefs and to justify his actions.

In most controversies there is a measure of truth on each side. Ideas like organisms must undergo a struggle for existence. Out of the clash of ideas truth finally emerges. In the long run intelligence wins, and the fittest ideas survive. In spite of relapses to savagery and ever-recurring periods of violence and disorder, human history is a record of substantial social progress: slow and halting progress, it is true, but still, great progress. James McCosh was taking this longer view when he wrote:

"In the end thought rules the world. There are times when impulses and passions are more powerful; but they soon expend themselves, while mind, acting constantly, is ever ready to drive them back, and to work when their energies are exhausted."

Through the complexities of our day and generation we may hope to find our way only by using such intel-

lectual light as is available, and by encouraging all honest search for further enlightenment. Time and further experience are the great correctives of ignorance and error.

It is a function of government to sustain the search for knowledge, and thus to promote peace. Much easier is it to promote hostilities; for fear is a very powerful emotion; prejudices are easily engendered, and turned to hatreds in the name of patriotism. It is on evil emotional drives that tyrants ride to power. Such drives are always conducted in the name of patriotism.

We do well to remember that the nation is an organism, whose health and expectation of life are encompassed in the well-being and good will of its constituent persons.

There is a better kind of patriotism than that which encourages ethnocentric boasting, racial hatreds, selfish national aggrandizement, and readiness for aggression. It is the patriotism that prizes individual freedom; that acknowledges imperfection and seeks betterment in orderly ways; that permits constructive criticism without encouraging muck-raking for the joy of seeing decent people hold their noses; that sustains the general welfare; that seeks to be great in self control and in security; great in equality of opportunity for all its citizens; great in its contributions to knowledge and to social betterment; and great in making its flag a symbol of freedom and a harbinger of peace on earth and good will toward all mankind.

Inherited from our animal ancestry are the two great evil tendencies of greed and fear: but happily there came with these evil propensities two countervailing motives of

desire for truth and willingness for service. In the fulfillment of these better urges lies the hopes of humanity.

There is a vast deal of kindness in the world. When youth ventures and triumphs the world applauds. The human spirit rises in exaltation with every great public betterment, and falls in humiliation when animosities divide and waste its substance, and shatter its hopes; when the Utopian dream is wrecked by personal conflict, disputation, and greed.

This will be a better world to live in when the resources of reason have been better organized and more adequately implemented for control. Our folkways prescribe small limitations to the rule of force and greed: only such controls as have been stumbled upon by the method of trial and error in the past; and reason has not made sufficient progress in its beneficent work of sifting out the error and evil, and redirecting the enthusiasms and energies of the world in better ways.

We need to recognize the animal origin of human nature, mental as well as physical, not to magnify it, and certainly not to laud it, but to understand it; for understanding leads to control.

Chapter XX

RELIGION IN ITS BIOLOGICAL ASPECTS

The two great stabilizing agencies in human society are government and religion. Government is coercive, executing the public will; religion is persuasive, bringing to bear the public conscience. Government controls by force in matters that are amenable to statute law; religion deals with more intimate personal relations that the law cannot reach. Government seeks to command; religion, like science, undertakes to explain[1] and interpret.

The student of biology should be sympathetic toward all religion, for religious activity is the form of behavior that is most peculiar to the human species. It is the product of a mind that looks before and after; that considers causes and effects; that weighs not only the immediate results of an act, but also the consequences that are more remote.

Since animals have so little idea of causality it might be thought that religion can have nothing in common with biology, until we note how closely throughout the world religious observances cluster around the biological crises of life: birth, puberty, marriage and death. In

[1] The fundamental idea in all religion is causality."—D. G. Brinton.

every land there are christenings following birth, initiations or confirmation in adolescence, weddings to celebrate marriages, and funerals following upon deaths. These ceremonials are more generally observed by all peoples than are any others. Each of these events presents to the mind of man unfathomable mysteries, confronted with which everyone becomes religious.

There is nothing in the behavior of animals that we may properly call religion. There is a so-called "sun-worshipping" lemur in Madagascar that is said to climb a rock at sunrise and stand erect, gazing to eastward with hands outspread; but this would seem to mean hardly more than the sunrise singing of the hoolock gibbon, and that hardly more than the morning songs of birds. It is not far removed, however, from the behavior of the Natchez Indian chieftain who stood at the door of his tent at sunrise, lighted his pipe, and held it forth toward the rising sun, saying "Smoke, Sun."

The light of the morning quickens all diurnal animals to new activity. The vivifying effect of the sun is so evident it is no wonder that sun worship was one of the earliest forms of religion. The beauties and the wonders of nature everywhere stir to religious feeling. The bounty of nature leads to sentiments of praise and thanksgiving. In our hymnals there are songs for the morning, songs for the evening, songs for seedtime and for the time of harvest. It is a dumb and unresponsive soul that is not moved with some feeling of religious exaltation in the presence of the natural grandeur that glorifies the earth. Religion seeks to know the riddle of life, and in emotional experience to appropriate the good and avoid the evil.

It will help us to understand the relation between religion and science if we realize that the first man upon the earth could know only what he found out for himself. He was confronted with a world full of mysteries: mysteries of many kinds. There were events occurring every day that had no visible causes. There was the blowing of the winds. Whence did they come? Whither did they go? Why did they shift, and wax, and wane? Why blow in gentle zephyrs now, and again in terrifying storms?

Overhead were the stars varying in brilliancy and in constancy, some fixed in position, others moving in definite companies, others straying alone. What did their position and their movements mean?

He knew himself as a causative agent, and he conceived other causative agents like himself, only more powerful. He personified the winds and named them: Boreas was the north wind; Auster was the south wind; Vesperus was the west wind; etc. On the margins of old maps in our libraries one may still see pictures of these mythical persons with roundly puffed-out cheeks blowing in opposition toward the center. He personified the constellations and named them—Orion, Pleiades, and the others. Neptune ruled the waves and Jupiter hurled the thunderbolts. These have been called man's "baby-names" for the forces of nature. Such were the results of his first attempts at explaining natural phenomena.

Then there were casualties betimes, that called for explanation. There were tempests and floods, volcanic eruptions and earthquakes, pestilences and famines.

There were sickness and death. All these things were hurtful, capricious, and irresistible. In the face of such calamities "Help wanted" was, and is, and ever will be, the cry of the whole world.

Again he conceived of causative agents, like himself but invisible, free-ranging and all-powerful spirits. Like himself they were capable of anger and of vengeance, capable also of kindness and of mercy. He conceived of them as persons, and often he called them gods. Among them were many kinds of gods, good and evil. There were malignant gods that must be placated with gifts to satisfy their greed, with rites to allay their anger, and with favors to cajole their malevolence. Because they could inflict so great injury, these evil gods were worshipped most, and thus fear came to be the chief characteristic of primitive religion.

But there were also kindly gods that had conferred great blessings, such as the knowledge of plants and animals fit for food and clothing and of plants and other earth products useful for healing. These gods must be worshipped and besought to continue their favors. Some of our American Indians had attained to the idea of one beneficent god, the Great Spirit; and there is a particularly fine prayer to him quoted in Lindquist's *The Red Man in North America,* which runs as follows:

Iroquois Prayer to the Great Spirit

"We are grateful for thy favors. We are grateful for all that has been given us. Continue to bestow these favors and withdraw them not; thy children live by thy

bounty and without it we cannot live. Continue to listen and inhale this sweet incense as we speak to thee; forget us not, for we are here by thy power begotten, and without thy favor we shall despair."

The great hardships of life that so dominated the thinking of primitive man were in two principal categories as to fatality. They were first the things that must inevitably happen, and that nothing could prevent. All that could be done about these things was to seek to foreknow them: and to that end he invented the methods of divination and augury, oracles and prophesy. Then there were the evils that would come unless something were done to forestall them. For dealing with these, he developed magic and ritual. He had lucky days, and lucky numbers, and talismans, and fetishes, and charms in thousands, many of which still linger in our midst, though taken far less seriously now.

He thus shaped his practices in accordance with his scanty knowledge. His religion was consistent with his science. These early efforts at understanding and adjustment are by no means to be despised. They are first steps upward in the sphere of mind, and they are peculiarly human.

Then there were mysteries of a more personal nature. When sickness and death were all about him he asked himself hard questions—questions for which modern science has no answer. Whence had he come? Whither would he go? His body would decay, but what of the spirit that governs? And to these questions he framed such answers as his limited knowledge and experience would allow.

"Religion reduced to its lowest terms is belief in the order of nature controlled by mind." This is an indispensable belief, common to all mankind. In the beginning the control was believed to be simple and direct. Man conceived the controlling spirits to be like himself in their needs and in their passions—only far surpassing him in their powers. They worked wonders and miracles, and these were no breach of natural law so long as that law was not understood. They were only manifestations of power.

The study of nature removes many occurrences from the realm of miracle, revealing proximal forces and the laws under which they operate. The mind in control is removed ever farther from the immediate event. The understandings first arrived at require amendment. A belief which has gained currency, and has long served as an anchorage for the mind in the midst of the mysteries of life, is slow to change. It is often far easier to make new discoveries than to alter old beliefs. New ideas lack the support of tradition. As Dr. D. S. Jordan has said, "Much that we have called religion is merely the debris of our grandfathers' science."

The simple panaceas of magic, so satisfying to the primitive mind, with the progress of knowledge cease to afford relief. The mystic control vanishes, but the weakness of the flesh remains. The mystery of birth lies behind us. The certainty of death is before us. Life's "fitful fever" runs its swift course. The ancient question comes anew "If a man die, shall he live again?"; and whether or not we insist on an answer, we must as social beings find some way of meeting the exigencies of life and of making

adjustment to them. We are ushered upon the stage of life through crises that we know naught of, and we are removed by forces we cannot stay. There is no other recourse than an appeal to a higher power which seems to rule eternally, and of which the high-lights of our little lives seem to afford passing glimpses.

Religion is universal among men because of the universality of human need. Kipling has expressed this need in "Kabir" as follows:

> "My brother kneels (so saith Kabir)
> To brass and stone in heathenwise;
> But in my brother's voice I hear
> My own unanswered agonies.
> His God is as his fates assign;
> His prayer is all the world's—and mine."

Doing came before thinking—comes before thinking still. The crises of life had to be met with scant knowledge of their nature and causes. How very scanty is our knowledge still! Observations were made and judgments spoken and traditions became established before science had made much progress.

Religious observances are in the folkways, where they have been developed for the maintenance of the social order. Like other folkways they are common to members of a group and differ in different groups. Dealing as they do with the inner life of men they are less altered by environment than are other folkways; and though originating like the others in comparative isolation, they may long survive contact with the customs of other groups of

people. In former times when races and peoples were better segregated than now, it could be said by an ethnologist that "Religion and a language make a people"; but in our own day and in North America at least, where people from many lands commingle, diverse religious practices flourish side by side. Religion is one, but religions with their varied ceremonials are many.[2]

Religious observances are concerned first of all with the guidance of instinctive behavior, keeping it to decent and orderly ways. In times of peace they are effective in sustaining good behavior. In times of stress they may be quite overruled by surges of popular passion. Usually they teach peace on earth and good will toward men, but in time of war they eagerly aid in building the morale for effective fighting. Some of their clergymen stop teaching the eternal verities and start brandishing the tomahawk.[3]

In the Middle Ages the church was opposed to undertaking the Crusades until the war spirit overwhelmed it; then it turned and blessed the preparations, and bade the crusaders God speed. It was "borne along like a chip on the tide." In no other department of human activity is it more evident that the springs of human conduct are instinctive. Let no one imagine that he can understand history or the power of religion in human affairs without taking instinct into account: it is the "root layer" in the nature of man.

[2] Religion is like the fashion. One man wears his doublet slashed, another laced, another plain; but every man has his doublet. So, we differ about the trimming."—John Selden in *Table Talk.*

[3] "Zeal is a dreadful termagant
That teaches saints to tear and cant."
—Samuel Butler, in *Hudibras.*

Religion is as much a product of natural evolution as is any other kind of human activity. It grows out of the exercise of the two better instincts of human nature: the instinct of curiosity, the desire to find out, to know and to feel, and the instinct to yield allegiance and service to beneficent control. It has developed by the slow and blundering method of trial and error; indeed, no better method of progress seems as yet to have been considered admissible.

The sustenance of decency and reverence in human society has always lain in the teachings of religion. Excesses in the exercise of power by rulers have been held in check by their restraint. Even in patriarchal days the "Old Man," ruling by the might of his strong right arm, might pause when some one made bold to tell him, "You may do this wicked thing that you propose now, but there is a higher power that will get you in the end, and that will recompense you according to your deeds." Before there were churches there were prophets of truth and soberness, who were the uncrowned leaders of the people.

A stabilizing function of religion in society is the teaching of the duty of obedience. Because of this it has been called "The Keystone of Government." On the other hand it has also been called a "soporific," made use of by corrupt rulers to keep people quiet under oppression. Although such abuses have been all too frequent in the past, and although religious leaders have at times misused their powers and privileges, let no one think of removing religion from the ways of a people until the inquiring human mind ceases to be curious about its own

origin and destiny, until the weakness of the flesh is no longer sustained by a belief in enduring realities.

Governments come and go, dynasties rise and fall, but the same old religions go on and on, binding the people in ties of spiritual fellowship, blessing their comforts, sustaining their hopes, softening their woes.

Government drives and organizes; religion leads and sustains.

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